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THE FLORIDA MULLET FISHERY

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MFR PAPER 1187

The Role of Fish in Meeting the World's Food Needs

L. J. RONSIVALLI

It is universally accepted that basic human needs are food, clothing, and shelter. Such a listing ignores the need for oxygen and water; these are, after all, taken for granted because they are not yet limiting factors in his environment. It is not by accident that food is listed before clothing and shelter. It is the only one critical to human survival. Our need for food is relentless, a fact of which we are constantly reminded at least three times per day, every day of our lives.

The world's human population, now at about 4 billion, is increasing at the rate of 2 percent/year, which means that it will reach about 8 billion within one generation. Unchecked, it is bound to outstrip any food production rate possible. Even if we ignore the impending energy shortage, there has to be a concern regarding the future of the world's food supply. There is no doubt that we can raise the food production efficiency of our arable land to a point, but its area is limited (about 8 billion acres). While we in the United States have generally enjoyed a higher standard of living than that of many others around the world, the effects of our technological advances in travel and communications have essentially melded the world's people, and the shortages in any large segment will affect the rest of the world. At present it is reported that there are only three major net food exporting countries in the world—Canada, Australia, and the United States—and already the large food reserves of this country have dwindled to a level so low that some economists have started to express concern. After all, there are too many factors that can readily curtail our food production which is one of the reasons a country tries to maintain food reserves.

Man's protein sources include plants and animals. Affluent populations have grown accustomed to the gustatory advantages of animal protein. However, the conversion ratio (lb feed/lb meat) of beef is about 10 to 1; hog, about 4 to 1; and poultry, about 2.5 to 1. From this we can see that the rising competition for grains is bound to push their prices to such high levels that the economics of producing beef will soon become less favorable, making it more costly and scarce. This situation will, of course, put economic pressures on hogs, sheep, poultry, and seafoods.

Many countries have already turned to the sea to obtain their protein foods, and the intensified fishing efforts worldwide have depleted many conventional species such as haddock, flounder, halibut, tuna, scallops, and lobsters. International management schemes have evolved in an effort to stem the decimation of the world's marine resources, but these efforts have been generally inadequate and extensions of national jurisdictions to 200 miles of the adjacent seas are proposed by many nations and already adopted by a few of them.

There is no doubt that seafoods play a significant role in supplying the world's protein needs. The world's per capita consumption is about 35 lb as against about 12 lb for the United States. However, the full potential of that role may not be reached until fish farming replaces fish hunting. The advantages of fish farming over conventional fishing are many:

1) Harvest is proportional to effort and much simpler and safer;
2) Conditions can be largely controlled (contaminants, disease, temperature, salinity, etc.);
3) Size of crop can be predicted and stocks easily and reliably assessed;
4) Genetics can be manipulated to improve yield, improve resistance to disease, shorten generation times, etc.;
5) Habits and life processes can be studied;
6) Feeding of fish can be controlled;
7) Operation not vulnerable to overfishing;
8) Requires no expensive fishing gear, ships, ship maintenance, and ship insurance;
9) Requires no sailing energy and time;
10) It is not dependent on weather;
11) Time between slaughter and process is very short insuring top quality;
12) No need for international agreement.

Fish are the most efficient converters of food, having a conversion ratio of about 1.5 to 1. Fish also require much less space than other animals (e.g., catfish space requirements are about 2,500 pounds per acre; silo systems can reportedly produce about one million pounds of fish per acre.) These facts suggest that fish for human use will eventually be produced largely by fish farming. However, the situation regarding the needs of protein for humans is already quite critical, and there are some things that can be done in the interim to increase the utilization of fish and fish products.

The technological research facilities

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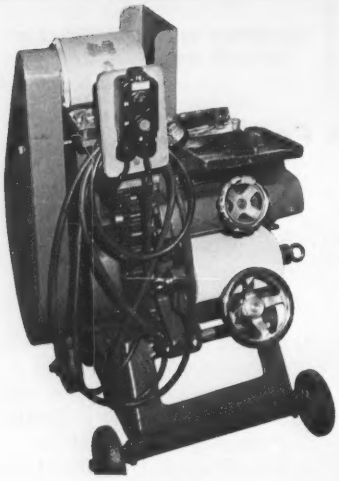

Photos show meat/bone separators used by the Northeast Utilization Research Center, NMFS, NOAA.

of the National Marine Fisheries Service (NMFS), NOAA, U.S. Department of Commerce in Gloucester, Mass., College Park, Md., and Seattle, Wash., have the goal of increasing the yield of the presently landed commercial fish products. Other research is directed towards increasing the landings and/or value of commercial fish. In collaboration with industry and Sea Grant colleges, a large portion of the effort is directed in a program to improve the New England commercial fishing industry.

Of the fish that are landed, only a relatively small proportion is normally used for consumption. For example, in shellfish about 15 percent of the landed weight actually goes into human food. In groundfish, about 30 percent goes into human food. In laboratory tests, we have shown that deboning machinery permits the recovery of an additional 10-20 percent of fish flesh in the form of minced meat. Shellfish (e.g., crabs and lobsters) can also be processed by automatic equipment which permits recovery of significant amounts of additional fish flesh. It has been estimated that in New England alone the additional fish meat that can be recovered by these processes is about 57 million pounds per year (King and Carver, 1970).

The machinery used for recovering the meat from finfish is basically of two types. One type is such that the product is pushed against the outside of a rotating perforated cylinder. The pressure put on this product forces the soft flesh through the perforations in the cylinder and the meat which passes through the holes collects inside the cylinder in a minced form. The undesirable materials such as the bone, skin, and scales stay on the outside of the cylinder and are collected elsewhere. A second principle involves forcing the product into a perforated cylinder under sufficient pressure to expell the soft flesh through the perforations while the undesirable materials are pushed to the end of the cylinder, collected, and removed. In addition to recovering meat from the processing of by-products of conventional species, this machinery can process fish which otherwise are not processed, either because of the bone structure which prevents filleting or because of the size which makes filleting too expensive for the yield. The fish are generally processed whole except that the head and viscera are removed. Laboratory tests have shown that fish processed in this manner yield from 62 to 93 percent of original weight as edible meat. In general, the smaller fish account for the larger percentage yields and the large fish

account for the smaller percentage yields (King and Carver, 1970).

The principles that are employed commercially to automatically debone shellfish include separation by specific gravity, that is, by floating in a liquid, usually brine, with a specific gravity such that it optimizes the separation of flesh from bone or cartilage. Centrifugation is a modification of the principle of separation by specific gravity that accelerates the separation. In addition, there are developments using pressure (e.g., air pressure or water pressure) to push out the meat and vacuum to pull the meat out of the cartilaginous sockets. Shaking has also been found to be effective.

Another way to take advantage of the presently available fish proteins is to encourage fishermen to land species which are presently underutilized, such as Jonah crabs, mahogany quahogs, Pacific rockfish, and certain oysters. Although markets have to be developed for most of these products, which presently have a low value, their food value is theoretically as great as those of the species that are presently landed. It behooves us to encourage the industry to use these species not only because it permits the fisher a greater range of products that he can handle, but it also increases the amount and variety of marine protein that is available to the consumer and, in addition, it helps to maintain a species balance at sea. That is, if we fish for many species rather than for a selected few, there is a higher probability that the selected few will not be fished to extinction.

One of the outlets for the minced meat is in the production of blocks. There is presently a shortage of fillet blocks used mainly in the production of fish sticks and fish portions: two products which account for tremendous amounts of the fish that are consumed in many of the developed countries. Minced flesh can be used as a matrix for the manufacture of various types of rolls such as shrimp roll, etc., or it can be made into a paste as is done by the Japanese. They produce a paste called surimi, a basic material which can then be used to produce a wide variety of foods, including soups, sausage products, and others (Miyauchi et al., 1973). In underdeveloped countries, salting seems to be a popular way to preserve fish. Thus, fish caught during glut can be preserved for the future or for inland transport where there is no refrigeration. For this purpose, at least two or three rapid salting techniques have been developed, and the NMFS has accounted for one of these (Anderson and Mendelsohn, 1972).

The use of mechanically recovered fish flesh is not without problems. The product does not resemble conventional products in physical appearance, and its texture, color, and flavor are not as stable as those of conventional products. Sometimes the product can contain bones, not always large bones but nevertheless bones which are undesirable and that may, in the case of feeding of children or elderly people, even be dangerous. A water-wash during the production of minced meat can improve the color of the product mainly by washing from the fish flesh the blood pigments and dark lining of the body cavity which disparage the esthetics and quality of the minced meat. The minced flesh of carp which is dark has been used as a component of frankfurters or hamburger. Hamburger mixed with up to 50 percent fish is as acceptable as plain hamburger (King and Flick, 1973). This represents certain advantages. It decreases the cost of hamburger without altering its eating quality. It improves the protein value since hamburger, which is ordinarily quite high in fat—up to 25 and 30 percent—is replaced by protein which could contain as low as one-half percent fat, and there is an overall reduction in calories. There is considerably less total fat since one-half of the fat has been removed, and this means that the total saturated fat is also halved. The small amount of fat that is added is polyunsaturated which, from a medical standpoint, improves the mixture of dietary fat. This is especially important since hamburgers and frankfurters are eaten selectively by the young, and it has been suggested that the cholesterol intake of the young has a lasting adverse effect.

The problem of texture depends largely on processing parameters. If minced fish flesh is used, as suggested earlier, as a component in hamburger, there is no problem. If the minced fish is used by itself, there is a noticeable toughening that reflects denaturation of the protein to a degree that is dependent, among other things, on the size of the openings through which the fish flesh is made to pass in the deboning operation. The smaller the openings, the greater the texture degradation.

The incidence of bone depends upon the nature of the raw material and of the parameters of the process. Obviously, fish having small bones and structured in particular configurations can be problematical. By varying the pressure, one can minimize the incidence of bones. If the openings in these recovery machines are small enough, 3 mm or less, the incidence of bone is not considered to be a problem. When the openings are less than one mm in size, any bone fragments getting through are so small that they cannot be detected by a trained panel.

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Dockside Price Analysis in the Florida Mullet Fishery

JAMES C. CATO

INTRODUCTION

Commodity prices are affected by a large number of forces. Mullet prices are no exception. The seasonal quantities of mullet landed, volumes going into short-term storage, location of landings relative to the market, and consumers' incomes, tastes, and preferences all affect mullet prices. Policies and programs of regulatory agencies affect prices through their influence on supply and demand factors. Marketing and market development programs also often create new consumer demand for mullet which can result in both higher prices and production.

This paper is a discussion of the factors which affect Florida mullet prices and their relative importance. To accomplish this objective annual dockside prices since 1952 and monthly dockside prices since January of 1970 are discussed from both a total fishing standpoint and from price differences within the fishery at different locations of production.

ANNUAL PRICES

Florida mullet landings varied during the 1952-73 period from a low of 23.5 million pounds in 1968 to a high of 39.9 million pounds in 1966 (Fig. 1). This constitutes about 80 percent of annual U.S. landings. Annual prices moved in an opposite direction with a low of 5.25 cents reported in 1963 and a high of 11.03 cents in 1973. Annual prices were obviously responsive to the quantity of mullet landed. That is, the larger the quantity of mullet available the lower the price per pound received. All mullet price and quantity data were obtained from National Marine Fisheries Service publications (National Marine Fisheries Service, 1970-74a, b). During the past several years mullet prices in current dollars have been above average for the entire period and in fact reached the all-time high in 1973. However, in terms of real dollars (or a measure of the purchasing power of money received by fishers for their catch) prices have been relatively stable. The average producer has made no real gain in terms of gross purchasing power, unless of course the real cost of production decreased substantially.

Figure 1.—Annual mullet landings in Florida and annual average prices in Florida in actual dollars, and dollars deflated by the consumer price index, 1952-73.

Estimated Price Functions

An estimated price response equation for mullet using annual data is given in Table 1. Regression coefficients give information concerning the effects of the quantity of mullet, other finfish landed, and personal incomes on the dockside price of mullet. The coefficient −0.29 means

Table 1.—Regression equation for annual dockside mullet prices, Florida, 1952-1973[1].

Dependent variable	Constant	Independent variable [3]			R^2	Durbin-Watson statistic
		Q_t	QF_t	IF_t		
P_t	15.9017	−0.2922 (4.70)	−0.0006 (.42)	.0439 (1.50)	0.65	0.83

[1]Number of observations is 22. The t statistic for each regression coefficient is shown in parentheses. The usual formula for computing the standard errors of regression coefficients are based upon the assumption that successive observations are random. In actual practice, the unexplained residuals for successive years may be significantly correlated. In such cases, the usual formula underestimates the standard errors of regression coefficients, thus overestimating the t values. The Durbin-Watson statistic for the equations indicate there may be some serial correlation.

[2]Dependent variable is:
P_t = Annual average price in cents per pound in year t.

[3]Independent variables are:
Q_t = Annual quantity landed in Florida in year t in millions of pounds.
QF_t = Annual quantity of all other finfish landed in year t in Florida in millions of pounds.
IF_t = Total personal income in Florida in year t in billions of dollars.

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that for each one million-pound increase in the annual quantity of mullet landed, a decline of 0.29 cents per pound can be expected in annual mullet prices with the values of other variables affecting mullet prices held constant. Stated in another manner, a increase of 3.42 million pounds will cause a one cent decline in annual prices. Florida total personal income was used to determine the effect of income changes on mullet prices. Although mullet are consumed primarily in the total Southeast, essentially no difference was determined by using total Southeast income. Quantities landed of all other finfish in Florida did not seem important in influencing mullet prices. The estimated price-quantity relationship given in Table 1 is plotted in Figure 2 with the remaining variables held at their mean values.

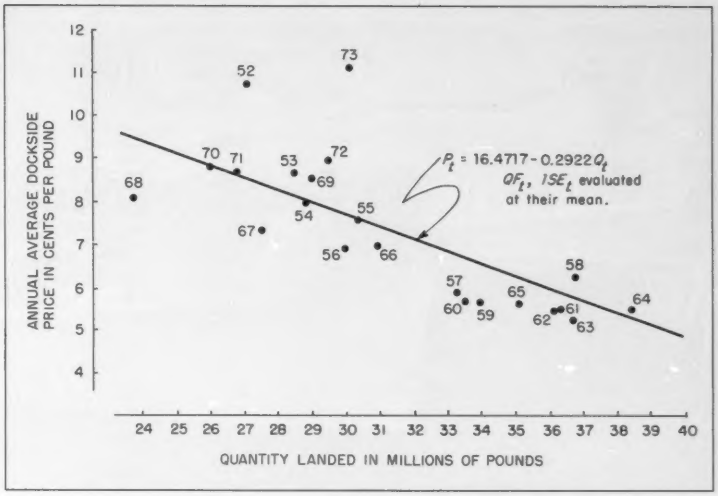

ANNUAL AVERAGE DOCKSIDE PRICE IN CENTS PER POUND
QUANTITY LANDED IN MILLIONS OF POUNDS
$P_t = 16.4717 - 0.2922 Q_t$
QF_t, $1SE_t$ evaluated at their mean.

Figure 2.—Annual dockside mullet prices and quantities landed in Florida from 1952 to 1973 and estimated price function for mullet using equation in Table 1.

Price Differentials

Prices paid to fishers vary significantly with area of catch. Price differentials among five production areas in Florida demonstrated that in some years there was as much as 3 cents per pound difference between the lowest and highest price areas (Fig. 3). The five production areas selected for analysis included ten counties with two contiguous counties making up each of the five areas. Lee and Collier counties together produced 27 percent of total mullet landings in Florida in 1971-73, more than any other two counties. The five areas combined landed 64 percent of Florida's total for 1971-73 with Sarasota-Manatee, Franklin-Wakulla, Citrus-Levy, and Brevard-Volusia contributing 16.7, 8.5, 6.3, and 5.3 percent, respectively.

Beginning in 1965, definite price differentials emerged[1]. The Franklin-Wakulla area now consistently has the largest price differential from Lee-Collier, which was used as the base for comparison. This differential normally ranges between one and two cents per pound. The Citrus-Levy area, for the last 5 years, also yielded higher prices than the Lee-Collier area by as much as 1.5 cents. Between 1964 and 1969 the Citrus-Levy area fluctuated with prices for 3 years higher than the base and prices for 2 years lower than the base. In the Sarasota-Manatee area prices were higher than in the Lee-Collier area between 1966 and 1969 (usually less than 0.5 cent higher) but since 1970 average prices were as much as 1.2 cents below the Lee-Collier average. The Brevard-Volusia area continues to fall below the base price in a range of from 1.0 cents to 1.5 cents per pound.

Since 1970, mullet landings in all five areas except Sarasota-Manatee trended slightly upward, with average prices also trending upward. Relative quantities landed in the five areas and production differences give no indication that production differences have

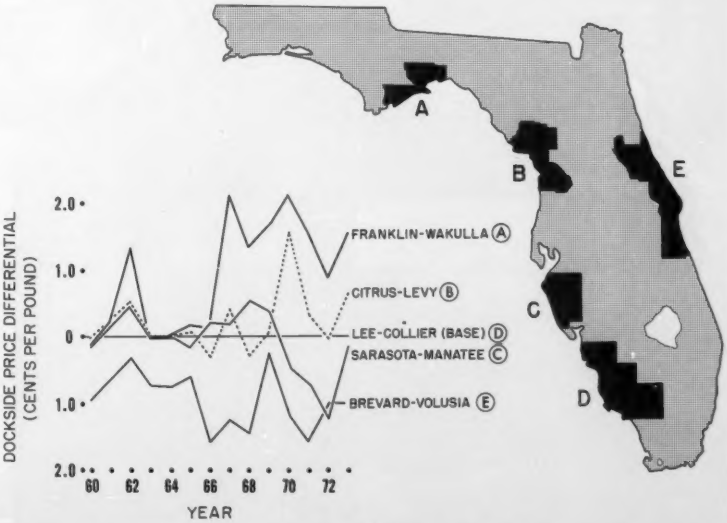
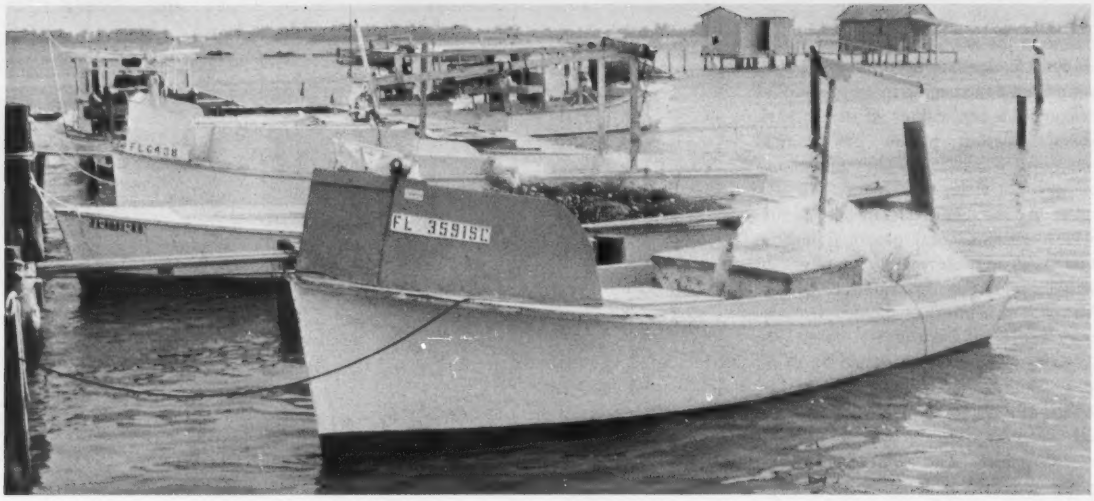
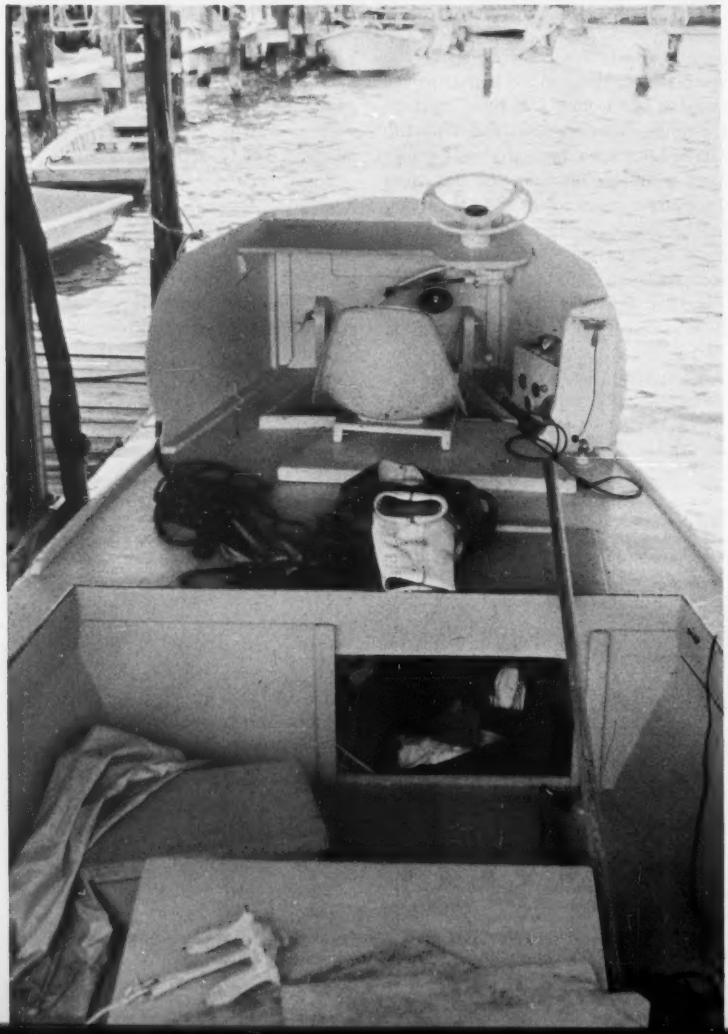


Figure 3.—Annual average mullet price differentials for five major production areas in Florida using Lee and Collier County price as base price, 1960-73.

[1]Examination of price data for species other than mullet indicate that several species showed quite similar prices in all areas of the state during 1963 and 1964. County price data were determined by dividing the county values of landings by pounds landed. During 1963 and 1964 it is possible that the data reporting technique used was to derive an average statewide price and use this price to estimate county landings values. This would have resulted in similar prices for all counties.





Boats (above and left) used in the mullet fishery are normally no longer than 24 feet. These two basic types are inboard boats with the controls located in the extreme front portion of the boat. This leaves room for an icebox and adequate working area.

caused the divergences appearing in 1964, 1965, and 1966. However, two of the lower production areas, Franklin-Wakulla and Citrus-Levy, do have higher prices than the other areas. Lower landings, combined with the locational advantage of being closer to southeastern markets such as Atlanta, may explain the higher price.

MONTHLY PRICES

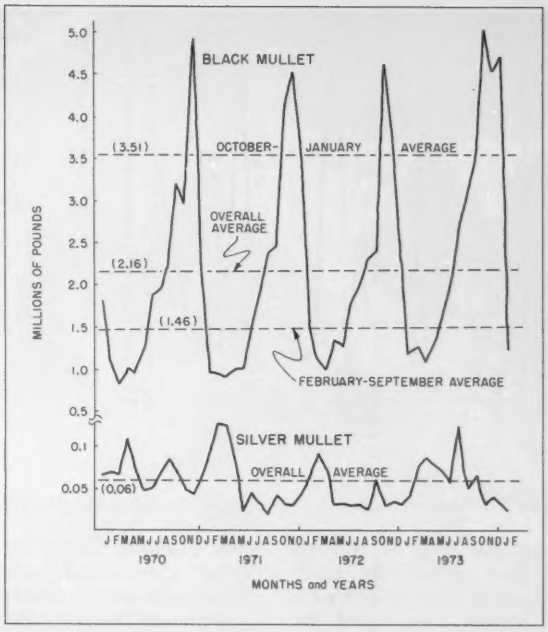
Seasonal and monthly variations in prices occur for a number of reasons. These include weather, social customs, holidays, and changes in the amount of mullet caught. For example, if the same amount of mullet were available each month, prices might vary due to holidays and seasonal consumption patterns. If the demand for mullet is the same each month, the amount caught would determine the price.

Black or striped mullet dominates the Florida mullet catch with four other species known to exist (Futch, 1966). Black mullet, *Mugil cephalus* Linnaeus, and silver mullet, *Mugil curema* Valenciennes, are reported as commercial catches in Florida.

Price-Quantity Relationships

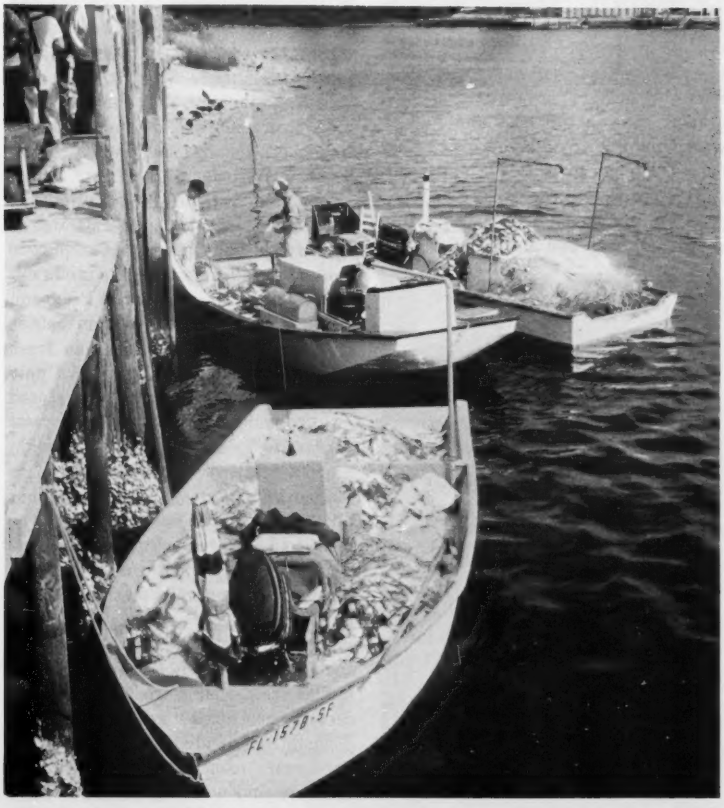
Black mullet spawn principally from November through January. Before

Figure 4.—Monthly landings of black mullet and silver mullet in Florida, 1970-73.



spawning, mullet form large schools and migrate from their typical estuarine habitat into offshore water (Futch, 1966). Formation of large schools and concentration in estuarine areas before going offshore causes mullet harvesting to increase drastically from September through January when they "run" and are more easily caught. Catch weights are also increased since most of the catch consists of mature spawning adults. Roe has always been a valuable by-product of the mullet catch but recently has become more important. See Futch (1966) for a detailed description of the black mullet and Smith (1972) for an indication of the importance of mullet roe.

Monthly landings of black mullet range from a low of slightly less than 1 million pounds in February through April to highs of between 4.5 and 5 million in December (Fig. 4). The October-January average since 1970 is 3.51 million pounds, the February-September average is 1.46 million, and the overall monthly average is 2.16 million pounds. Monthly average landings of silver mullet was about 60 thousand pounds. Silver mullet landings peak a little later than black mullet with high production months usually February and March.



This type of boat is called a "well" boat and is powered by an inboard motor mounted through an opening in the hull.

Average monthly statewide price of mullet received at dockside shows an inverse relationship with the quantity caught. When the amount of mullet produced by fishers is at a peak, the price received is usually the lowest (Fig. 5). Largest quantities landed normally occur in December and lowest prices received occur in December and January. Conversely, lowest quantities landed are normally in March and April, with highest prices received in May and June.

Prices received on the Florida West Coast where the major production occurs are normally higher than on the East Coast—in fact, in only 4 months of the 50 months covered in this study were average East Coast prices greater.

Estimated Price Function

Price and landings data from January 1970 through February 1974 were

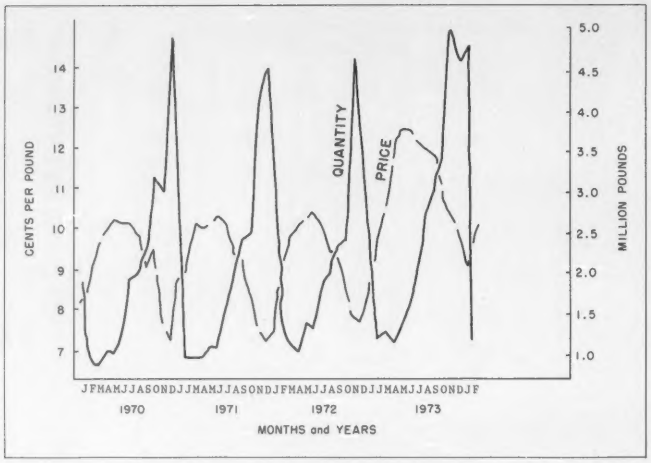


Figure 5.—Monthly landings and dockside prices of mullet in Florida, 1970-73.

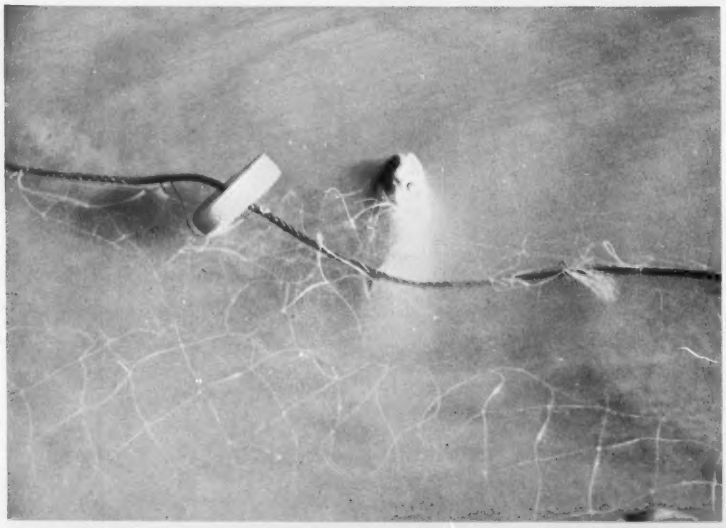
used to estimate a price response equation based on monthly observations. The data used and plotted in Figure 6 require some initial discussion. Dots on the figure represent the monthly price-quantity observation for the months of February through September of each year. This shows that higher prices were received during the months when quantities landed were relatively low. Monthly price-quantity relationships during the "run" months when larger quantities are landed are indicated by the X's and show that lower prices are received when quantities landed are highest. Circled observations indicate the plotted price-quantity relationships for April through December 1973.

This apparent shift in demand was primarily the result of increased activity in the roe market. Expectations were high that the demand for roe in Japan and France would be much greater than in the past and buyers were willing to pay a higher price than before. Efforts in late 1972 and early 1973 to develop roe markets were probably instrumental in causing this shift in demand. See Smith (1972) for a complete discussion of this marketing program by the National Marine Fisheries Service. January and February prices in 1974 fell back closer to their normal pattern but from March until August 1974, the latest data becoming available since the analysis was completed, prices have ranged from 12 to 14 cents per pound and demonstrated a price-quantity relationship consistent with the April-December 1973 demand level. The effect on price in any given month was estimated for changes in quantity landed, income, quantity of other finfish landed, and a demand shifter for the April-December 1973 period.

Often with a particular species the quantities landed in one or more previous months affect the current month's price in a similar manner as the current month's landings. When fish can be frozen and/or stored for any period of time this is likely to be the case. Wholesalers might buy a sufficient quantity of fish to satisfy their market for a period of 2 months and then be less willing to purchase mullet during the current month except at a much lower price.

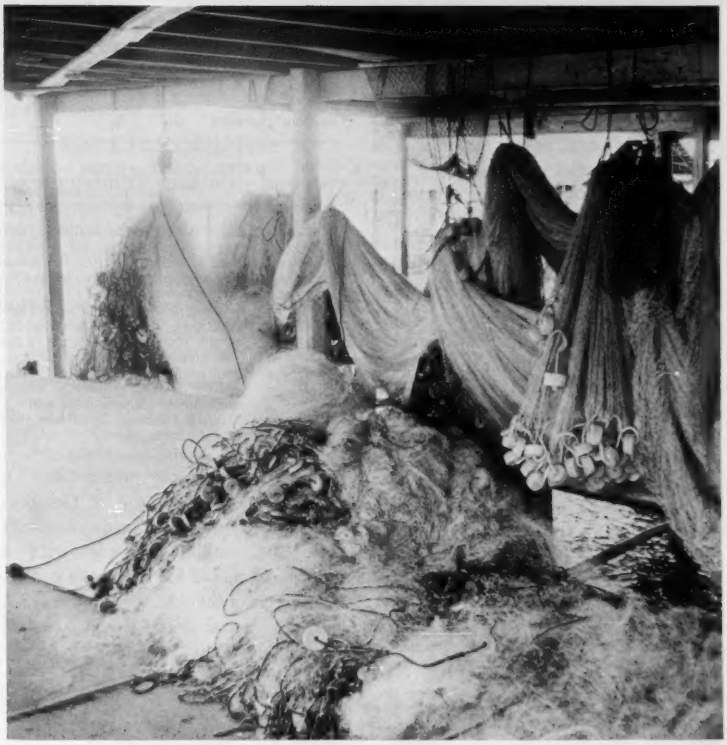
Mullet cannot usually be stored for more than a 60- to 90-day period unless frozen in the round. Two primary reasons exist for this. First, mullet flesh after any processing tends to become unstable during storage due to the susceptibility of the flesh lipids to oxidative rancidity (State University System of Florida Sea Grant Program, 1974). This technical problem causes most mullet to be consumed in fresh form or after storage periods of only several months' duration, unless stored in the round. Second, storage costs relative to the value of mullet are high. Since a dealer or wholesaler can place lobster or shrimp with a much higher ($2.00 to $4.00 per pound) value in the same cold storage facility as mullet and at the same storage cost, it is not generally economically feasible to store mullet because storage costs alone might exceed half the dockside value of the mullet stored. However, some mullet are placed in frozen storage for certain specialized markets.

Quantities landed beyond the third or fourth month past the current month would not be expected to have an appreciable effect on price in the current month. Inclusion of monthly



Mullet are caught primarily with gill nets. Mullet fishers also catch other species such as trout, redfish, Spanish mackerel, pompano, and bluefish.

Mullet fishers maintain a substantial investment in nets—possibly as high as $15,000. Net size may range from 3-inch mesh nets to 4¾-inch mesh with several net sizes in between.



storage inventories in this analysis was not possible since these data are not available. Also, since storage inventories of mullet are likely to be small, a distributed lag model was used to analyze the effect of mullet landings on price.

The price response equation estimated using a first degree polynomial distributed lag model[2] is shown in Table 2. This model assumes that quantities in the current month have the greatest effect on the price with quantities in prior months becoming less important each month until the effect on price approaches zero. The effect on price of a one million pound increase in current month landings was 0.53 of one cent decrease[3]. A one million pound increase in the month prior to the current month caused 0.36 of one cent decrease. Third month landings prior to the current month had minimal price effects. Lags of 4 months and second degree polynomials were also examined. The estimated equation shown in Table 2 was selected as the "best"[4].

Changes in personal income and the 1973 demand shift dummy variable were also important. The shift in demand occurring during April-December 1973 caused a price difference of 2.33 cents to be paid for any given

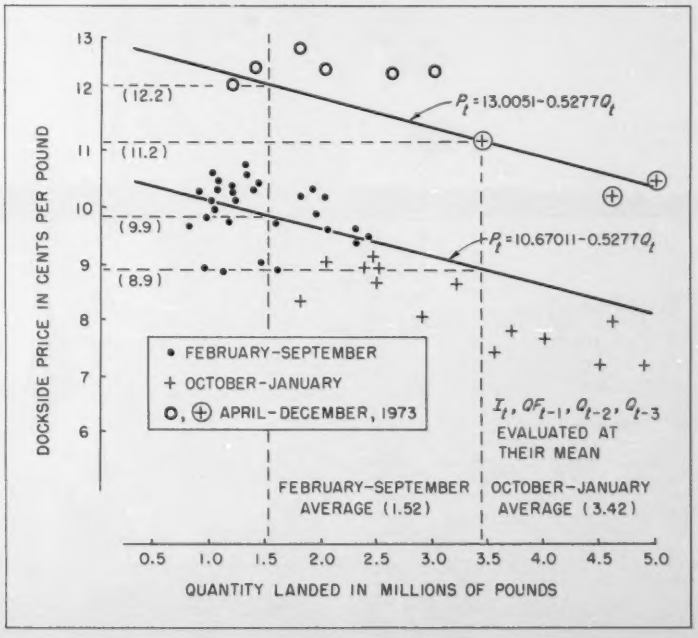


Figure 6.—Monthly quantity landed and dockside price of mullet in Florida from January 1970 to February 1974, and estimated price function for mullet using equation in Table 2.

[2]These models are often referred to as Almon lag models (Almon, 1965).

[3]The effect of a change in any particular variable on price is discussed with the effects of all other variables remaining constant. For example, interpretation of the −0.53 coefficient means that for a 1 million pound increase in landings in the current month price will decrease by 0.53 of 1 cent, with all other variables remaining constant.

[4]One difficulty in using a polynomial lag model is that the degree of the polynomial and the length of the lag must be specified at the time of model formulation. Normally, familiarity of the data and industry will provide insight into the most appropriate degree and length of lag. Variations of degrees and lag lengths can then be tested until the contribution of the additional lagged variables to the regression sum of squares is no longer statistically significant. Another possibility is to choose the length of lag which results in the highest value for the coefficient of determination corrected for degrees of freedom. Finally, these criteria in concert with the knowledge of the data will result in a "best" lag and polynomial degree being chosen. Nonlag models examined did not appear to give as satisfactory results as the distributed lag model presented in this paper.

quantity[5]. The direction of price changes was also consistent with those expected. For example, increases in income were associated with positive changes in price. Landings of other finfish did not seem important in influencing mullet prices.

The estimated demand curve is shown graphically in Figure 6. The lower curve represents the demand curve traced out excluding the price-quantity data from April through December 1973. The upper curve represents the demand curve during the 1973 period. For the approximately 4-year period studied, the average monthly quantity landed during February-September was 1.52 million pounds. Using the estimated demand curve this would result in a dockside price of 9.9 cents per pound (Fig. 6). During the "run" season of October-January, average monthly landings were 3.42 million pounds with a resultant price of 8.9 cents per pound.

Analysis of the April-December 1973 shift in demand shows the importance of demand shifts in price determination. As remarked earlier, anticipation during this time was high for a new roe market, particularly in Japan. Market anticipation encouraged buyers to pay higher prices than had been paid in the past. Those buyers bidding price upward for the roe market then caused other buyers to pay higher prices to retain their relative market shares. Inclusion of the demand shifter (D) for

[5]Dummy variables to measure differences in the intercept and slope of the demand curve during the "run" season were also examined. Low t values were associated with slope shifter parameter estimates so it was not included in the model. A model including the intercept shifter did indicate a significant difference in the intercept of demand curve during the "run" season. A complete examination of this model can be made in a forthcoming report on the Florida mullet industry to be published by the Florida Sea Grant Program.

Table 2.—Regression equation using first degree polynomial distributed lag model[1] for monthly dockside mullet prices in Florida[2].

Depend. Variable[3]	Constant	Independent variables[4] Q_t	Q_{t-1}	Q_{t-2}	Q_{t-3}	IF_t	QF_t	D	R^2	Durbin-Watson statistic
Pt	8.4718	−0.5277 (13.0)	−0.3551 (14.17)	−0.1825 (6.26)	−0.0098 (0.20)	0.1125 (3.88)	0.0013 (0.25)	2.3350 (9.50)	0.92	1.60

[1]Models of this type are discussed in Almon (1965); Nerviove (1968); and Kmenta, Jan. 1971. Distributed lag models: A survey. Unpubl. manuscr. Michigan State Univ.
[2]Observations were from January 1970, to February 1974. Numbers in parenthesis are t values.
[3]Monthly dockside average price of mullet in Florida in cents per pound in month (t).
[4]Independent variables are:
Q_t = Monthly landings of mullet in Florida in current month (t) in millions of pounds.
Q_{t-1} through Q_{t-3} = Monthly landings of mullet in Florida in months prior (t—1, t—2, t—3) to current month (t) in millions of pounds.
IF_t = Total personal income in Florida in month (t) in billions of dollars.
QF_t = Monthly landings of all other finfish in Florida in month (t) in millions of pounds.
D = Zero-one shifter variable for months of April through December 1973, to indicate a demand shift during these months.
1 = April through December 1973.
0 = All other months.

Fishing is sometimes done in water shallow enough to wade.

this period resulted in the upper demand curve in Figure 6 with resultant prices of 12.2 and 11.2 cents per pound, respectively, during the average "summer" and "run" seasons.

Significance of causing upward shifts in the demand for mullet becomes apparent. Upward demand shifts occur for several reasons in addition to the shifts caused by population, income, and changes in other products. One shifter is new markets for a product, as is evidenced by the effect of the roe market on total demand. Another shift might occur from market promotional activities to make consumers aware of a product or new uses of a product. Successful promotions can be expected to shift demand upward. A third, but related reason, would be a technological improvement that would allow new products to be produced from mullet. Solution of the rancidity problem allowing the more versatile use of mullet flesh in new and different products would undoubtedly cause an upward demand shift.

PRICE FLEXIBILITIES

Price-quantity flexibilities show the percent change in price resulting from a 1 percent change in quantity given that the effects of other variables affecting price remain constant[6]. The percentage effect of mullet quantities landed on mullet price are shown in Table 3.

[6]Price-quantity flexibility was computed as $\frac{\partial P_t}{\partial Q_t} \cdot \frac{Q_t}{P_t}$, where:

$\frac{\partial P_t}{\partial Q_t}$ = partial derivative of estimated mullet price response equations with respect to quantity of mullet landed, and

P_t, Q_t = arithmetic means of mullet price and quantity variables used to estimate equations.

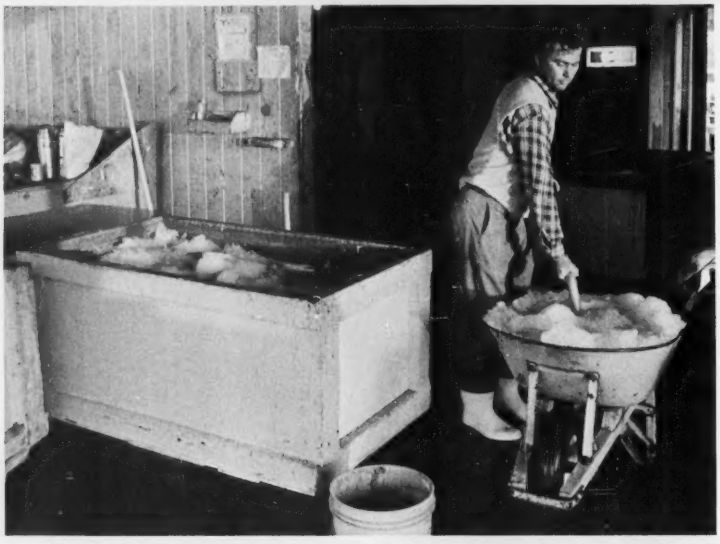
Table 3.—Price-quantity flexibilities for Florida mullet based on monthly, bimonthly, quarterly and annual data.

Equation used	Type of data	Price-quantity flexibility
From:		
Table 2	monthly	—0.123
Table [1]2	bimonthly	—0.129
Table [1]2	quarterly	—0.184
Table 1	annually	—1.251

[1]A model identical to that in Table 2 was used with monthly data transformed into quarterly and bimonthly observations, respectively.

The argument would normally be made that prices become more flexible as the time or period for price adjustment becomes longer, particularly when storage of any commodity is possible. For example, buyers will store mullet purchased at lower prices when possible to satisfy their needs in coming months. During these coming

Other fishing occurs in the bays with the entire operation handled from the boat.



Mullet are handled at the fish house by washing and placing on ice and under refrigeration.

months when supplies may be more limited purchases will not be necessary at the higher price since storage holdings are available.

The degree of responsiveness will in part depend on the length of time mullet can be stored. Since most mullet are consumed fresh and storage periods in general range from no longer than 3 to 4 months, less flexible prices with respect to quantities landed would be expected monthly than on a bi-monthly, quarterly, and annual basis. The shorter the time period under consideration, the more available are storage holdings and the less price responsive are buyers to changes in quantity.

Mullet dockside price-quantity flexibilities followed this pattern. The flexibility based on monthly data of -0.123 means that for a one percent increase in quantity of mullet landed there would be 0.123 percent decrease in price. Aggregation of the monthly data into bimonthly and quarterly observations and the resultant price response equation estimations led to price-quantity flexibility estimates of -0.129 and -0.184. The price response on the bimonthly basis was fairly similar to that on the monthly basis while the quarterly estimates yielded a somewhat more price flexible response. Beginning with the 3-month period buyers must become more price responsive to quantities landed since storage beyond that time period becomes less likely. On an annual basis, a one percent increase in quantity landed resulted in a 1.251 percent decrease in price. Storage over the period of one year is virtually non-existent. Buyers are then quite price responsive to changes in the quantities of landings.

Approximation of price-elasticities from the price-quantity flexibilities also allow some comparisons of the effect on total revenues of production increases and decreases. Approximated price elasticities from the monthly, bimonthly, and quarterly price-quantity flexibilities are -8.13, -7.75, and -5.43, respectively[7]. Since the absolute values of these are greater than 1, fishers should be able to land more mullet in the short run and accept the lower price with resultant higher total revenues. This is predicted on the assumption that the fish are available and will be purchased.

Price-income flexibilities were computed on a monthly and annual basis. These estimates were 0.2616 and 0.0676, respectively, and indicate the percentage change in price resulting from a one percent increase in income, with all other variables affecting mullet prices remaining unchanged.

INDUSTRY IMPLICATIONS

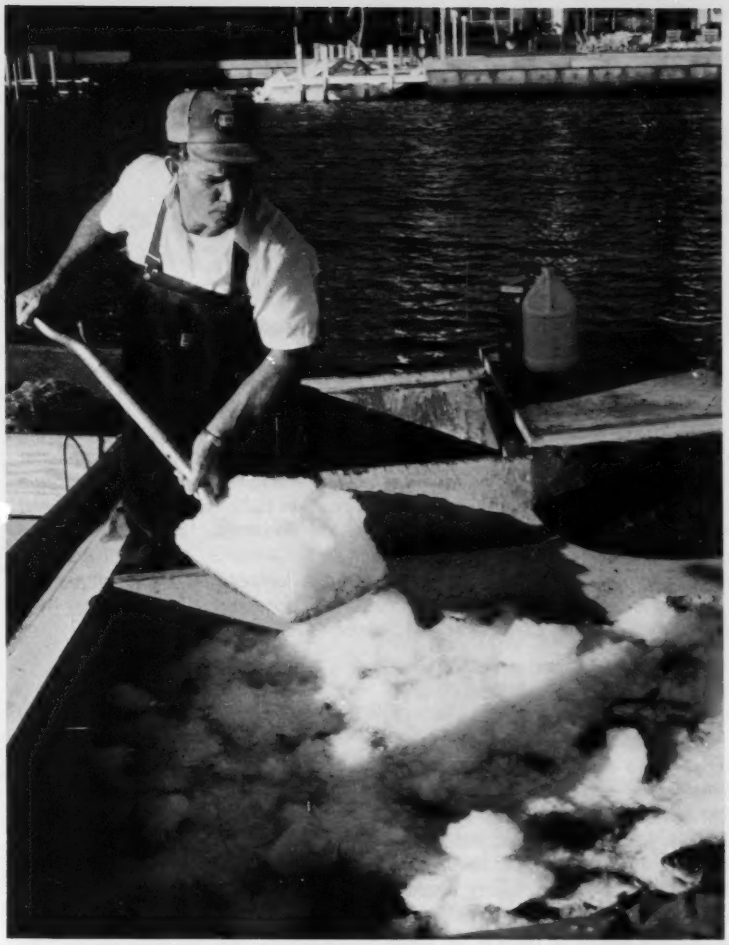
Fishers are perhaps more conscious of the prices received for the mullet they catch than any other segment of the industry. Each is a price-taker, and individually can do little to influence prices at the dockside level. Just as the consumer has the option of refusing to

[7]Computed by taking the inverse of price-quantity flexibility. This is not the true elasticity of demand but is an acceptable approximation for this use.

buy mullet if the price is too high, fishers have the choice of not fishing for mullet if the price they receive is too low to cover expenses and give a return for their labor and management. But, in the short run, bills must be paid and not fishing at all on an individual basis is not a very satisfactory alternative.

Therefore, to get higher dockside prices for mullet, two improvements are necessary. These are more markets and new products. This analysis showed the effect of a demand shift on dockside prices. Assuming that development of the roe market was instrumental in causing the demand shift as discussed in this paper, a resultant dockside price increase of 2.3 cents per pound was felt as a result of this market program. Continuation of this type effort to develop other markets and new uses for mullet will be necessary to further the improvement of dockside prices. New markets and products must be developed for mullet, and the technological problems of storage and rancidity must be solved to make this feasible.

New products, markets, and improvements in the storage capability will also contribute to the solution of the seasonality problem in the industry. Since major production occurs during a 4-month period when the market becomes glutted and prices are low, new products and markets would take the pressure off this over-supply, depressed price period and provide the producers with possibly higher and certainly more stable prices. Storability would also insure processors and manufacturers of new mullet products a constant month-to-month supply. Markets are hard to develop and maintain with nonstorable seasonable production. It will take an effort from all segments of the industry to implement these improvements and realize higher mullet prices.



Quality mullet are produced using ample ice. This fisherman stores his catch between layers of ice as it is taken from the net.

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MFR PAPER 1189

Distribution, Age, and Size of Tagged Adult Steelhead Trout in the Snake River Drainage

LYLE G. GILBREATH, LARRY R. BASHAM, and EMIL SLATICK

ABSTRACT—Steelhead trout, Salmo gairdneri, *were tagged as adults at Little Goose Dam on the Snake River during the 1972 and 1973 spawning migrations. Recovery rates of tagged fish from the recreational fishery upstream from Little Goose Dam were 21.3 percent and 13.1 percent in 1972 and 1973, respectively. A 61 km section of the lower Snake River now flooded by Lower Granite Dam produced 42.6 percent of the sport catch in 1972 and 37.9 percent in 1973. Information was also obtained on the ocean-age composition of the fish and the timing of migration and size of steelhead trout recovered in four different river areas, including the Clearwater and Salmon River systems of Idaho.*

INTRODUCTION

In the past, the lower Snake River supported a high quality recreational fishery for steelhead trout, *Salmo gairdneri*, returning to spawning grounds in Idaho, Oregon, and Washington. Construction of dams has nearly eliminated this fishery because the fishing gear now used is ineffective in catching steelhead trout in the pools above dams. The recent completion of Lower Granite Dam (February 1975) has inundated a 61 km section of the lower Snake River, further reducing the area available to the fishery.

In addition to losses to the recreational fishery, dams have altered the river environment to the detriment of anadromous fish. Serious declines in the escapement of adult steelhead trout to the Snake River drainage in 1973-74 have been attributed to passage problems at these dams, particularly turbine-related mortalities of seaward migrants (Raymond, 1974[1], and Collins et al., 1975[2]). Gas bubble disease, resulting from high concentrations of dissolved atmospheric gas (Ebel, 1971), has been described as an additional cause of mortality of both juvenile and adult migrants.

Since 1968, the National Marine Fisheries Service (NMFS) has been conducting experiments to determine whether transporting valuable stocks of juvenile steelhead trout and Pacific salmon, *Oncorhynchus* sp., around dams on the Snake and Columbia Rivers could increase their survival without affecting their ability to home to parent streams (Ebel et al., 1973; Slatick et al., 1975). The fish were transported in tank trucks containing oxygenated water.

Returning adult steelhead trout from these studies were captured and tagged at Little Goose Dam in 1972-73. The object of this tagging was to determine the distribution of these steelhead trout in the Snake River drainage and to assess the relative contributions of different areas to the recreational fishery, particularly the section of river to be inundated by Lower Granite Dam. Information on the timing of migration, size, and ocean-age composition of adult steelhead trout in the Snake River was also obtained. This report describes the results obtained from the tag recoveries.

MATERIALS AND METHODS

Steelhead trout utilized in this study were the adults returning from smolt releases that were marked to evaluate the transportation experiments conducted in 1969-72 at Ice Harbor and Little Goose dams by the NMFS. These fish had been tagged as juveniles with magnetic wire tags (Jefferts et al., 1963), cold branded with liquid nitrogen (Mighell, 1969), and released near the point of capture (control condition) or below Bonneville Dam (test condition). A device to detect magnetized wire tags on adult fish and to separate these tagged fish from the untagged fish (Ebel, 1974) was installed in the fishway at Little Goose Dam in 1972.

This facility operated during the adult migration seasons of 1972-73, automatically separating steelhead trout with magnetized wire tags from the rest of the population ascending the fish ladder. Each migration season covered portions of two calendar years. For example, steelhead trout from the 1972 run were captured at Little Goose Dam from the late summer of 1972 through the spring of 1973. Steelhead trout bearing wire tags were anesthetized, examined for cold brands, weighed, measured, and externally tagged with a dart or a jaw tag[3]. A scale sample was also taken for use in age studies.

Most tag returns were obtained directly from anglers but a substantial number (181) were recovered at the Dworshak and Pahsimeroi fish hatcheries. A few were also incidentally recovered in a creel census by Idaho Fish and Game Department personnel.

Lyle G. Gilbreath, Larry R. Basham, and Emil Slatick are with the Northwest Fisheries Center, National Marine Fisheries Service, NOAA, 2725 Montlake Boulevard East, Seattle, WA 98112.

[1]Raymond, H. L. 1974. Snake River runs of salmon and steelhead trout: trends in abundance of adults and downstream survival of juveniles. Northwest Fisheries Center, National Marine Fisheries Service, NOAA, Seattle, Wash. Processed rep., 6 p.

[2]Collins, G. B., W. J. Ebel, G. E. Monan, H. L. Raymond, and G. K. Tanonaka. 1975. The Snake River salmon and steelhead crisis: its relation to dams and the national energy crisis. Northwest Fisheries Center, National Marine Fisheries Service, NOAA, Seattle, Wash. Processed rep., 30 p.

[3]Dart tags were size FT-2 manufactured by the Floy Tag Company. Jaw tag sizes ranged from 12 to 28 and were manufactured by the National Band Company. Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Figure 1.—Map of study areas showing the Snake River and its major tributaries.

Most tag returns from the recreational fishery were assigned to one of four major river areas (Fig. 1):

1. Lower Granite area: Lower Granite Dam to the confluence of the Snake and Clearwater Rivers at Lewiston, Idaho (about 50 km), thence upstream 10 km on the Snake River and 10 km on the Clearwater River.
2. Middle Snake River: About 160 km of the Snake River, from 10 km above Lewiston to the Hells Canyon Dam.
3. Salmon River system: The Salmon River and its tributaries.
4. Clearwater River system: The Clearwater River 10 km above its mouth and its tributaries.

The division of the river into four major segments enabled us to assess contributions to the recreational fishery from the area to be flooded by Lower Granite Dam, the mainstream Snake River, and the Salmon and Clearwater River systems.

Tag Recoveries

During tagging operations at Little Goose Dam, 696 and 1,387 adult steelhead trout were tagged in 1972 and 1973, respectively.

Tag recoveries from all sources for the 1972-73 seasons totaled 203 and 334 (29.2 and 24.1 percent), respectively. In both seasons, the ranking of areas by number of returns were: 1) Clearwater River system, 2) Lower Granite area, 3) Salmon River system, and 4) Middle Snake River. Downriver areas produced a small number of recoveries from spawned-out steelhead trout returning to the ocean, primarily during the 1972 season. The majority (21.3 percent in 1972) of the fish were recovered from the fishery. The Lower Granite area was the foremost producer, with 42.6 percent of the total recreational catch in 1972 and 37.9 percent in 1973. Recoveries from the other major areas ranged from 13.5 percent in the Middle Snake River to 20.2 percent in the Clearwater River during 1972 and from 8.8 percent in the Middle Snake River to 23.6 percent in the Clearwater River during 1973 (Fig. 2).

Timing of Recoveries

The recovery pattern by month for the four major catch areas was similar in 1972 and 1973 (Fig. 3). During both seasons, the Lower Granite and middle

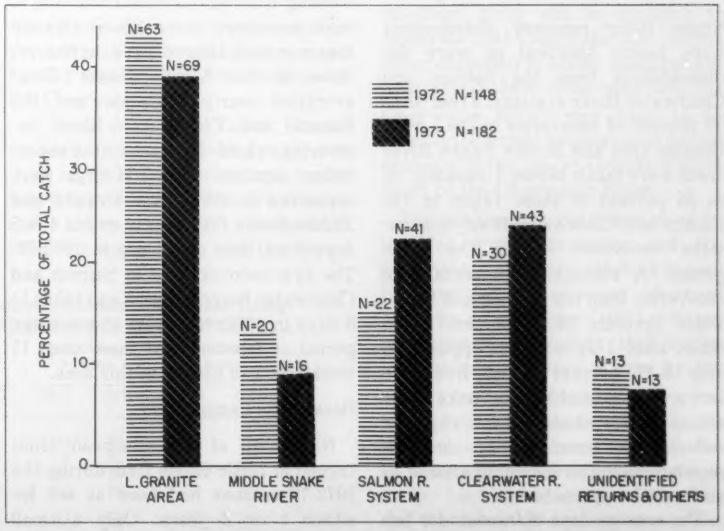

Figure 2.—Recovery (percentage of total catch and numbers of fish) of marked steelhead trout taken by recreational anglers in the different river areas, 1972-73.

Adult steelhead trout with lower jaw tag and cold brand (top) and cold brand tag (bottom).

Snake River recovery distributions were nearly identical as were the distributions from the Salmon and Clearwater River systems. From 83 to 95 percent of recoveries in the Lower Granite area and Middle Snake River areas were taken before 1 January; 48 to 65 percent of those taken in the Salmon and Clearwater River systems were recovered during the same period. A substantial percentage of recoveries from the Salmon and Clearwater systems (35-52 percent) were taken after 1 January, as opposed to only 5-17 percent taken from the Lower Granite and Middle Snake River areas. The distribution of catch by time reflects the proximity of the fish populations to the spawning ground as maturation approached.

The average days of freedom for fish taken in a given area were similar for the 1972 and 1973 seasons. Steelhead trout recovered in the Lower Granite area averaged about 4 weeks at liberty; those in the Middle Snake River averaged nearly 6 weeks; and the Salmon and Clearwater River recoveries, about 12 weeks of freedom before capture. The first tags were recovered in the Lower Granite and Middle Snake River areas within 4 to 5 days from time of release in 1972-73. The first recovery in the Salmon and Clearwater River systems was taken in 8 days in 1973; however, the average period of freedom was more than 11 weeks for fish caught in this area.

Ocean-Age Composition

Nearly all of the steelhead trout tagged at Little Goose Dam during the 1972-73 seasons had been at sea for either 1 or 2 years. Only a small number (less than 0.5 percent of fish tagged) spent 3 years in the ocean.

The ocean-age composition of steelhead trout tagged at Little Goose Dam during the 1972 season was 54 percent 1-ocean, and 46 percent 2-ocean; for the 1973 season, the composition was 40 percent 1-ocean, and 60 percent 2-ocean. We believe the ocean-age composition noted in the 1973 season more nearly represents the usual composition of Snake River steelhead trout. The unusually large percentage of 1-ocean fish in 1972 was probably due to large numbers of smolts wire-tagged in 1971 compared to a relatively small number tagged in 1970 (2-ocean returns in 1972). Age composition among the four areas of the recreational fishery varied considerably with the Lower Granite area having the highest percentage of 2-ocean fish in both 1972 and 1973. The Middle Snake River catches had the highest percentage of 1-ocean fish in 1972; but in 1973, the Salmon River had the highest percentage of 1-ocean fish.

Length and Weight

Length of 1-ocean steelhead trout captured at Little Goose Dam during the 1972-73 seasons ranged from 48 to 75 cm (average 62 cm); weight varied from 0.9 to 4.5 kg and averaged 2.4 kg. Length of 2-ocean fish ranged from 59 to 100 cm (average 82 cm); weight ranged from 1.8 to 10.2 kg with an average of 5.6 kg. The five 3-ocean fish that were recovered ranged from 83 to

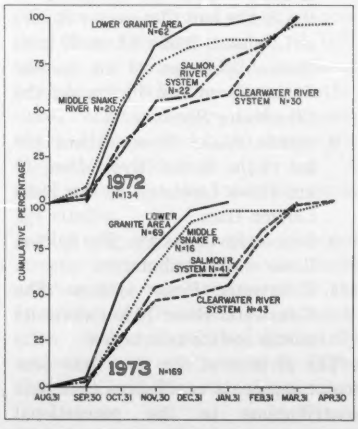

Figure 3.—Recovery (cumulative percentage) of marked steelhead trout taken by recreational fishers in the different river areas by month during 1972-73.

Lower Granite Dam

96 cm in length and weighed from 6.0 to 10.4 kg.

The size of fish taken in the sport fishery was essentially the same as that observed at Little Goose Dam. It appeared, however, that the average size for a given ocean-age group was larger in areas immediately above the dam (i.e., the Lower Granite area and Clearwater River) compared to upriver areas such as the Salmon River.

DISCUSSION

Steelhead trout ascending the Clearwater River are known to be predominantly 2-ocean age while those ascending the Salmon River are 1-ocean[4]. Tag returns during this experiment further substantiate these findings (Table 1). There is obviously some variation in the ocean-age composition of steelhead trout ascending the Snake River from year to year. It is our opinion, however, that the percentage of 1-ocean fish we reported for 1972 was unusually high for all areas because only a small number of smolts were marked in 1970 (the 2-ocean year class). Steelhead trout recovered from the Clearwater River and the Lower Granite area were of the same general age (mostly 2-ocean), suggesting that the Lower Granite area was a major holding area for those fish destined for the Clearwater River.

A major part of the Lower Granite area is an interstate fishing area; that is, it is readily accessible and legally fished by residents of both Washington and Idaho. Fishery management problems may emerge with the virtual removal of this section of river from the fishery. For example, it now appears that Washington anglers will not be successful (Tri-State Steelheaders Inc., 1970) in catching highly-prized Clearwater River-bound steelhead trout as in the past, because the entire Snake River downstream from the Clearwater River is now a reservoir. Assuming that fish populations are restored to pre-1973 levels, more steelhead trout will be available to anglers in both Clearwater and Salmon River drainages in Idaho. Management programs in these areas (especially the Clearwater River) may have to be modified to adjust for increased fishing pressure if the Lower Granite fishery shifts to the Clearwater River.

Tag loss from the rigors sustained by the fish during migration and the nonresponse of anglers catching tagged fish are factors affecting observed recovery rates. Butler (1962) stressed nonresponse, concluding that angler interest and recovery efforts by the tagging agency were of primary importance. Creel census effort in this study was not a factor because the majority of tags were returned voluntarily. Lacking estimates of tag loss and the factor of nonresponse in our studies, the recovery rates reported should be considered minimal.

[4]Pers. commun. with Steve Pettit, Idaho Fish and Game Department, Lewiston, Idaho.

Table 1.—Ocean-age composition of steelhead trout recovered in the different fishing areas and at the Little Goose Dam adult separator during the 1972-73 seasons.

	No. of fish		Percentage 1-ocean		Percentage 2-ocean	
Recovery site	1972	1973	1972	1973	1972	1973
Fishing areas						
Lower Granite area	62	69	47	22	53	78
Middle Snake River	20	16	72	50	28	50
Salmon River system	22	41	64	63	36	37
Clearwater River system	30	43	63	23	37	77
Total	134	169	58	35	42	65
Little Goose Dam	696	1,387	54	40	46	60

ACKNOWLEDGMENTS

The authors wish to thank the fisheries biologists and hatchery personnel from the Idaho Fish and Game Department and the Bureau of Sport Fisheries and Wildlife, who assisted in recovering tags at hatcheries and in the fishery. We are especially grateful to the many anglers who returned tags and provided us with essential data for this study.

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MFR PAPER 1190

Understanding Radiation Energy and Its Use in the Preservation of Seafoods

L. J. RONSIVALLI

THE NATURE OF RADIATION

Radiation can be defined as the transfer of energy from one place to another through space. Good examples of this are the transfers of light and heat, two different forms of energy, from the sun to the earth. The earth also receives other types of radiant energy from the sun as well as from other radiating bodies in outer space. Cosmic rays and Xrays are two more examples of these external radiations. Now, it must be made clear from the start that there would be no life on earth if it were not for most of the radiations it receives. For example, without light, all photosynthesis would cease. To put it simply (Fig. 1), photosynthesis is the process by which plants grow by the action of the sun's light on the green substance (chlorophyll) they contain. Of course, without the sun's heat, the earth would steadily grow colder and all things would finally become completely frozen.

On the other hand, the amount of radiation which is directed toward the earth is greater than we actually receive. In fact, it would be harmful if all of it were to reach us. Fortunately, our atmosphere acts as a screen, stopping much of the radiation (Fig. 2) and we get just enough to sustain life on the earth. While we are on the subject, it might be informative to point out that our bodies have a built-in mechanism to protect us from the harmful effects of the normal radiation we receive. Cosmic rays reach the earth from outer space incessantly, and it is estimated that each person receives about 50 cosmic ray hits every second. It would seem that this radiation rate is tied in to our natural ability, as an evolutionary development to withstand a certain amount of radiation. Of course, when we receive too much radiation, we become ill, and when the excess is great enough, the radiation becomes deadly.

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RADIATION IN OUR NORMAL DAILY ROUTINE

Besides the radiations which we have just discussed, it is pertinent to note that we make other encounters with radiation in our normal daily routine. One example is vitamin D, which is added to ordinary milk. Vitamin D is first produced by converting a chemical, which we can call provitamin D, into vitamin D by irradiating it with ultraviolet or gamma rays. The same effect can be had by exposing it to the sun. This is then added to milk as a supplement. As a matter of fact, vitamin D is normally produced in our bodies in exactly the same way. This chemical, which we called provitamin D, is situated just beneath our skin, and when we are exposed to the sun, its rays cause a chemical change producing vitamin D (Fig. 3). Vitamin D is necessary to maintain a balance of certain minerals in the body to prevent a disease called rickets.

Some of the more familiar types of radiation are ultraviolet rays (we see these used to sterilize glassware), radio and television rays, and Xrays. Differences in the length of these and of those of other radiations are shown in Table 1.

In some ways, Xrays, gamma rays, and cosmic rays are similar to the other forms of radiation we have mentioned, but they have one property which makes them different from most—they are highly penetrating. As we know, Xrays can be used to photograph the inner parts of our bodies. (Some might remember when Xray machines were used by shoe salesmen to make sure that a prospective customer was properly fitted). However, it has been found through experience that unrestricted exposure to Xrays can be

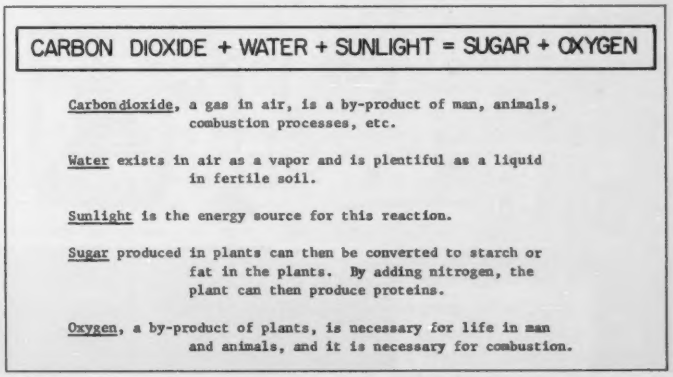

CARBON DIOXIDE + WATER + SUNLIGHT = SUGAR + OXYGEN
Carbon dioxide, a gas in air, is a by-product of man, animals, combustion processes, etc.
Water exists in air as a vapor and is plentiful as a liquid in fertile soil.
Sunlight is the energy source for this reaction.
Sugar produced in plants can then be converted to starch or fat in the plants. By adding nitrogen, the plant can then produce proteins.
Oxygen, a by-product of plants, is necessary for life in man and animals, and it is necessary for combustion.

Figure 1.—The basic reaction in photosynthesis.

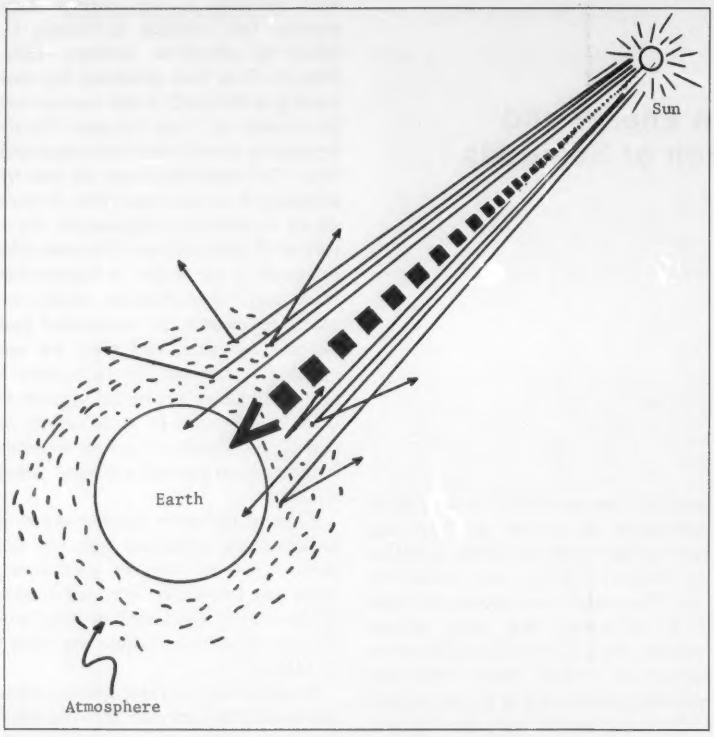
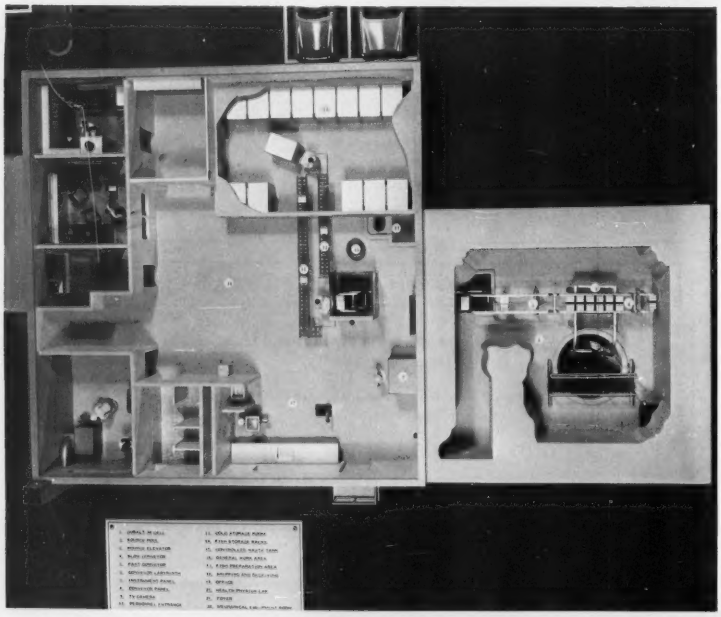


Figure 2.—Much of the radiation from the sun is deflected by the earth's atmosphere.



Floor plan of the irradiation facility at the Northeast Utilization Research Center.

dangerous, and there are now strict controls to protect both the patients and the medical people who use the Xray equipment. Of course, these findings eliminated the shoe Xray machine and other unnecessary exposures to Xrays.

For some time now, however, cancer patients have been treated with radiation. Since cancer is a mass of fast-growing new cells, and since radiation attacks new cells more easily than it attacks old cells, we can understand that when a thin beam of radiation is made to hit a cancerous tumor, the radiation will destroy it. We must recognize that the radiation will also cause some harmful effects to the good cells it unavoidably must pass through, but the harmful effects are considered to be minor compared to the beneficial effects. For the treatment of cancer, we mainly use gamma rays from radioactive cobalt.

We should mention that there exist on this earth natural radioactive elements. Perhaps the most important is carbon 14 (a radioactive form of carbon) believed to be largely produced by the action of cosmic rays on ordinary carbon. Since carbon is an essential element of all living things, as well as all things made from them, all animals and plants continue to add radioactive carbon throughout their normal life cycle. Measurements of radioactive carbon are used for estimating the age of bones, fossils, etc. because when a living thing dies, it stops adding radioactive carbon to its body, and consequently, there is less and less of it as time passes. Because all radioactive elements continually decay with the passing of time, radioactive carbon becomes ordinary carbon when it loses its radiation energy. Man also carries other radioactive elements, potassium for one, which can be found in the teeth and in the bones.

HOW RADIATION PENETRATES

One might wonder how an Xray, a gamma ray, or a cosmic ray can penetrate something solid, as a brick or a piece of wood, especially since we can see no evidence that this takes place. The explanation for this apparent mystery is that we can't see the detailed structures of the brick and the wood because of their extremely small sizes. It is the same as looking at a

cloud. We can see its shape, but because of the distance, we can't see the droplets of moisture of which the cloud is made. Down in the range of sizes, much too small for the eye to see, even with the help of a microscope, solid materials can be found to be made of very small particles with a lot of space between them. In fact, solids are really mostly empty space. A brick, as other solid materials, appears to us to have a shape because the particles of which it is made are held together in a sort of weave or pattern. It is similar to the weave in a cloth, but on a much, much smaller scale. The structure of such solid substances as a brick is so small that even the point of the sharpest needle cannot pierce it. In Figure 4, we can see represented a piece of finely woven cloth (top left), a needle (middle left), and a part of a brick (lower left). The dimensions of the parts in Figure 4 are not to exact scale. They are intended only to illustrate a message. The point of the needle is shown magnified one million times on its right. A point of the brick equal in size to the point of the needle is magnified one million times, and it is shown on its right. Likewise, a point between the fibers of the cloth is shown to the same magnification. Note that the top circle on the right is empty. It represents empty space among fibers in the fabric, which can hardly be seen with the naked eye. The circle in the middle represents the point of the needle. Notice that it is mainly empty space, but contains many particles. These are atomic particles of which the needle is composed. The bottom circle, representing the point on the brick, shows the detailed composition of the brick which is also mostly empty space. We can see that the entire middle circle could pass through the upper circle, because the upper circle is completely empty. However, the whole of the middle circle could never pass through any of the spaces among the particles of the bottom circle. On the other hand, gamma rays and Xrays, as well as cosmic rays, are much smaller than the smallest specks shown in the magnifications, so we can see that it is very easy for these rays to pass through the spaces among the particles.

These rays strike matter at the speed of light and although matter is mostly empty space, the rays eventually strike a particle, whereupon they lose some of their speed and are deflected from their course much like a cue ball which strikes one or more pool balls before it comes to rest. The thicker an object is, the more particles are available to block the rays which strike the object, and when the object is thick enough, the rays are slowed by too many collisions with particles and finally stop.

Because of their high speeds, however, these high energy rays are very penetrating. For example, it takes as much as 5 feet of solid concrete to hold back the gamma rays of the cobalt 60 source used in the research laboratory of the Northeast Utilization Research Center in Gloucester, Mass.

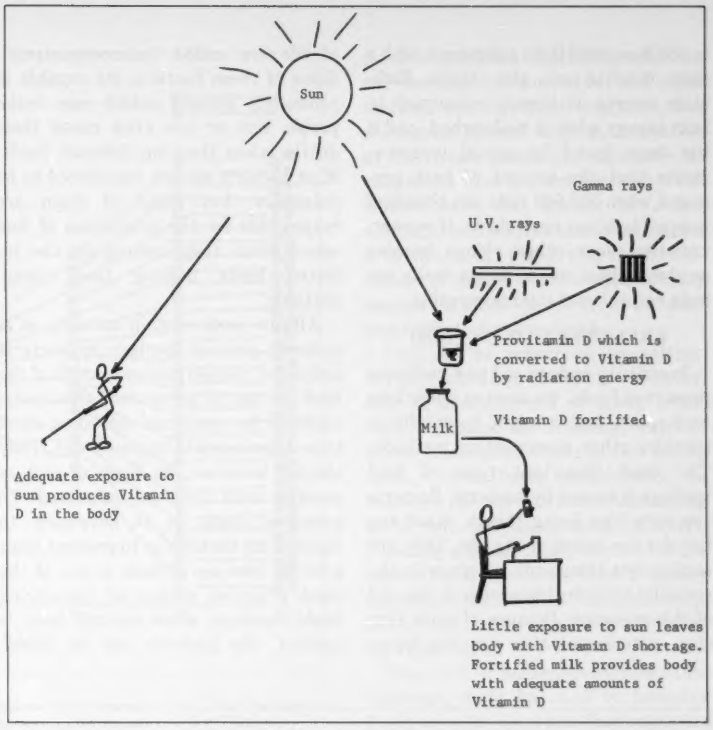

Sun
Gamma rays
U.V. rays
Provitamin D which is converted to Vitamin D by radiation energy
Milk
Vitamin D fortified
Adequate exposure to sun produces Vitamin D in the body
Little exposure to sun leaves body with Vitamin D shortage. Fortified milk provides body with adequate amounts of Vitamin D

Figure 3.—The body can get vitamin D directly from the action of the sun's radiation or indirectly by drinking fortified milk.

Table 1.—Wave lengths[1] of different energies.

Energy	Wavelength (approximately)
Electricity	1,000 to 10,000 miles
Radio	100 yards to 1 mile
Television	1 to 10 yards
Radar	1 inch
Infrared	1/1,000 inch (1 mil)
Visible light	1/10 mil
Ultraviolet	1/1,000 mil
Xray	less than 1/1,000,000 mil
Gamma	a little shorter than most Xrays
Cosmic	shorter than gamma or Xrays

[1]These energies are believed to follow a wave-like path as shown below. The length of the wave (L) is the distance between 2 peaks.

MEASURING THE RADIATION DOSE

Depending on the amount of radiation being produced, we can say that it is intense or not so intense. As with all other things that vary in intensity or strength, it makes it convenient to be able to measure radiation. For most applications, radiation is measured according to amounts received by a target. These amounts depend on the time of exposure as well as on the intensity of the radiation. The unit which has been chosen to measure the amount of radiation received is called a "rad", from the term radiation-absorbed-dose. The unit "rad", to measure radiation, is used in the same way that we use calories to measure heat, inches to measure length, and ounces to measure weight. A rad is an extremely small unit, and it might help

to see how small if we compare it with a more familiar unit, the calorie. Radiation energy is largely converted to heat energy when it is absorbed, and it has been found by actual measurements that the amount of heat produced when 500,000 rads are absorbed is equal to about one calorie. However, radiation does other things besides producing heat, so we cannot really use rads and calories interchangeably.

PRESERVATION OF FOOD

In order to understand how radiation preserves foods, we need to know how food spoils, and it might be helpful to consider other preservation methods. The most important type of food spoilage is caused by bacteria. Bacteria are very tiny living things, much too tiny for the naked eye to see. They are so tiny that thousands can grow in the space taken up by the period at the end of this sentence. Because of their tiny size, bacteria and other very tiny forms of life are called "microorganisms". Some of these bacteria are capable of producing poisons which can make people sick or can even cause their deaths when they eat infected foods. Most bacteria are not considered to be poisonous, but many of them are responsible for the production of foul odors when they decompose the infected foods making them unappetizing.

All raw foods contain bacteria, so in order to prevent spoilage by bacteria and other microorganisms, much of the food we eat is preserved. Obviously, foods to be consumed within a short time do not need to be preserved. They should, however, be kept as cool as possible until they are consumed. To preserve foods, it is necessary to destroy the bacteria or to prevent their growth. The use of heat is one of the most effective means of preserving foods, because when enough heat is applied, the bacteria can be killed. Foods preserved by heat must be packaged in airtight containers, usually cans, beforehand so that no bacteria can reinfect them after they have been heat-processed. Examples of heat-processed foods are corn, peas, stringbeans, etc. When foods are heat-processed in cans, they will last for years without any refrigeration.

Although many foods can be heat-processed, there are some which cannot tolerate much heat. Examples of these more delicate foods are milk and most fish. In the case of milk, it is "pasteurized" using smaller amounts of heat. By pasteurization, we mean that most of the bacteria are destroyed (about 99 percent), and the food is made safe to eat. However, since some bacteria remain in the food, it will eventually spoil within one to a few weeks. Furthermore, it is necessary to refrigerate the food to attain even that shelf life, because bacteria grow faster when the food is stored in a warm place. We can see the result of storing fish for just 12 hours at 42°F against storing it in ice by looking at Figure 5. The figure shows that for every 12 hours, one bacterium of a particular species forms two bacteria at 32-33°F, but at 42°F, one bacterium forms 64 bacteria. (Bacteria of other species have different generation times.)

Canned fruits can be preserved with less heat than corn or peas because fruits are classified as acid foods. Acid can be considered to be a preservative because it does not allow harmful bacteria to grow. This brings up the subject of preservation by preventing bacterial growth as opposed to preservation by killing the bacteria.

We can prevent the growth of bacteria by removing something the bacteria need or by adding something that they cannot tolerate. To begin with, we need to recognize that there are many different types of bacteria which vary widely from one another as to their requirements and as to the conditions they can tolerate. Some grow well in cold as well as in warm environments. Others grow well in warm environments rather than cold ones. Still others grow well in salt or sugar or acid, and so on. Fortunately, nearly all of the bacteria that grow in acid or in salt are not harmful to us.

The growth of poisonous bacteria is stopped when a food has a high acid

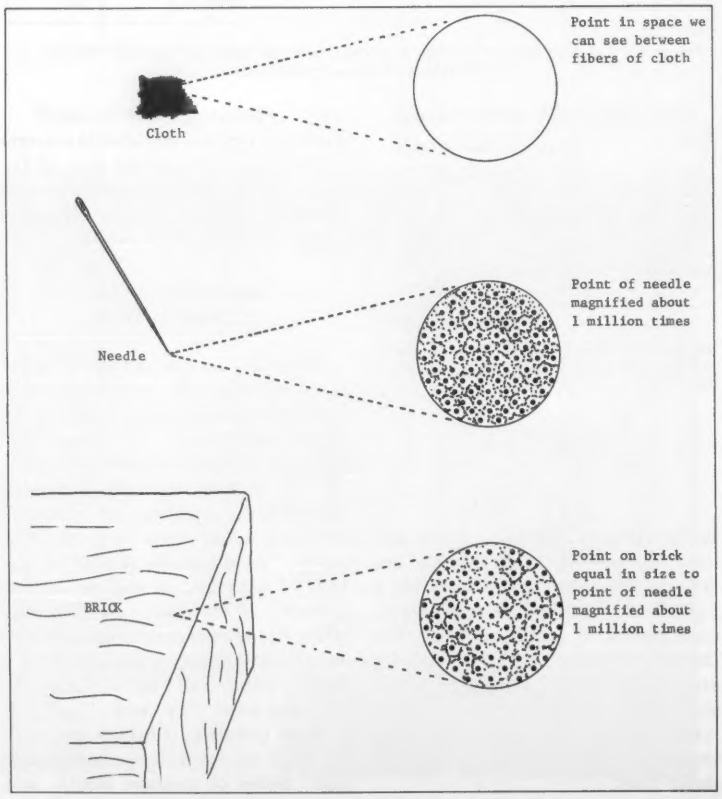

Point in space we can see between fibers of cloth
Cloth
Point of needle magnified about 1 million times
Needle
Point on brick equal in size to point of needle magnified about 1 million times
BRICK

Figure 4.—Million-fold magnifications of point of needle, point on cloth and point on brick.

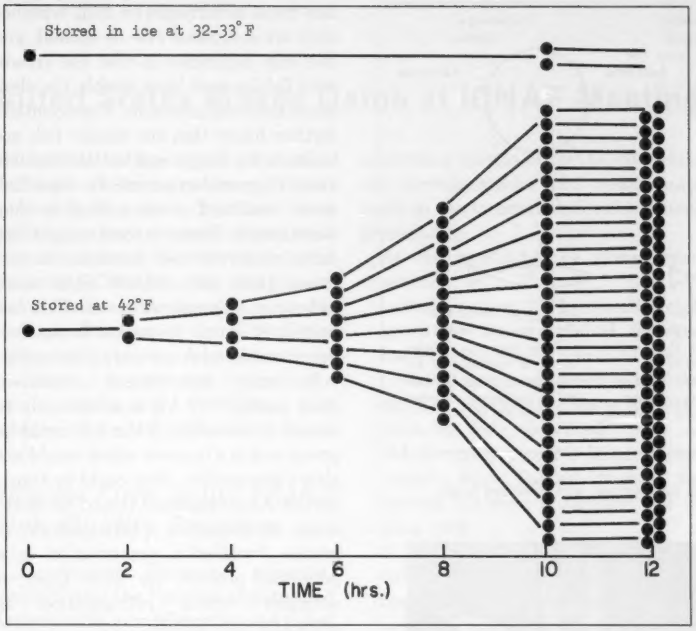


Figure 5.—The increase in number of bacteria on fish stored in ice (time between generations about 10 hours) and at 42°F (time between generations about 2 hours).

content, as in fruits, or when the salt concentration is high enough, as in salted fish. One way of stopping most of the bacterial growth is to remove the water from the food because bacteria need water to grow. Examples of this form of preservation are dried beans, dried milk, dried potatoes, etc. Another preservation method is to add chemicals that bacteria cannot tolerate, such as sodium benzoate, sodium nitrite, etc. In all preservation methods the object is the same—to prevent bacterial growth.

HOW RADIATION PRESERVES SEAFOODS

We discussed earlier how Xrays and gamma rays were able to penetrate even solid materials, at times colliding with atomic particles. For our purposes, we can think of gamma rays as microscopic bullets streaking through matter, hitting anything in their path and continuing on their way until they are finally stopped after many deflections. When a ray hits a bacterial cell, the impact is so damaging that it results in the death or crippling of the microorganisms. The details of radiation destruction of bacteria are complex and will not be discussed here.

Of course, the greater the amount of radiation passing through a food, the more hits there will be on the bacteria. Enough research has been carried out to show that a food has to receive about 5 million rads of gamma radiation in order to be sterilized (kill all the bacteria) and about 200,000 rads to be pasteurized (kill about 99 percent of the bacteria). Figure 6 shows bacterial contents of unprocessed, pasteurized, and sterilized fish.

It might be puzzling to learn that it takes 25 times as much radiation to kill the last 1 percent of the bacteria as it takes to kill the first 99 percent. This can be explained by the fact that bacteria are of different types, some more resistant than others. Some bacteria can form a hard shell called a spore, which is extremely resistant to radiation, heat, and other preservation methods, and requires all of the extra energy before they are destroyed.

WHY RADIATION IS DESIRABLE FOR PRESERVING SEAFOODS

We noted in an earlier section that many seafoods are too delicate to preserve by heat-processing. Of course, we know that some seafoods can be satisfactorily heat-processed; these include tuna, sardines, anchovies, and herring. Lobster, crab, and other shellfish are also heat-sterilized, but are not considered to be as acceptable as the fresh products, especially to consumers who are familiar with fresh lobster, crab, etc. Except for a few seafoods, we find that heat-sterilization is too drastic for preserving them. This is true for the fillets and steaks of many species of fish—in fact, even heat pasteurization is too harsh.

Fish can be preserved by salting, drying, smoking, pickling, freezing, and by combinations of these treatments. Except for freezing, each of these treatments changes the eating quality of seafoods considerably, so that they are not necessarily appetizing to anyone not accustomed to them. Freezing is theoretically the best of the conventional processes from a quality retention standpoint. Unfortunately, this theory is not completely supported by experience.

Since it first became recognized that radiation could be used to preserve foods some 20 years ago, food scientists have tested this processing method. It was found that the amount of radiation needed to sterilize fish was more than their quality could tolerate. However, seafoods could be pasteurized with low amounts of radiation without damage to their quality. Research laboratories of NMFS, as well as those in a number of universities, have conducted comprehensive research, under contracts to the U. S. Atomic Energy Commission, to show that most fish and shellfish can be satisfactorily pasteurized with a treatment of about 200,000 rads of gamma radiation. The most experienced food tasters could not detect any difference between the qualities of irradiated and nonirradiated fish. The researchers found that the shelf life of any conventionally-packed seafood could be doubled or tripled by treating it with 200,000 rads of radiation, which destroyed over 99 percent of the bacteria normally found in the fish. This type of treatment does not make the fish radioactive. When fish were tested for radioactivity afterwaves, none could be detected.

Using regular chemical analyses, the scientists found that radiation has little effect on the quality of seafoods. So, it is not surprising to find that fish preserved by radiation look and taste

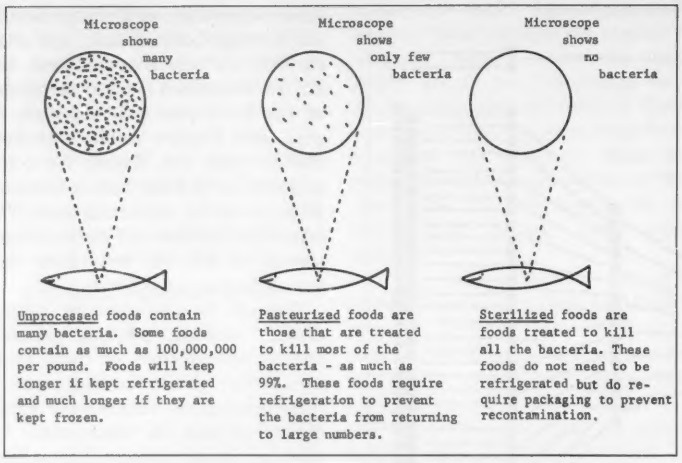
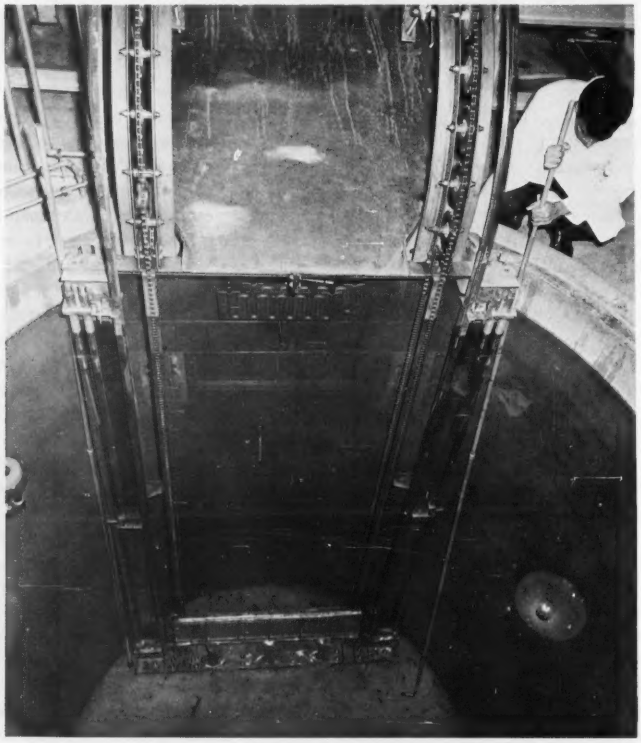

Microscope shows many bacteria
Microscope shows only few bacteria
Microscope shows no bacteria
Unprocessed foods contain many bacteria. Some foods contain as much as 100,000,000 per pound. Foods will keep longer if kept refrigerated and much longer if they are kept frozen.
Pasteurized foods are those that are treated to kill most of the bacteria - as much as 99%. These foods require refrigeration to prevent the bacteria from returning to large numbers.
Sterilized foods are foods treated to kill all the bacteria. These foods do not need to be refrigerated but do require packaging to prevent recontamination.

Figure 6.—Bacterial content of unprocessed, pasteurized, and sterilized foods.



Pool of clear water at the bottom of which is stored the cobalt 60 (in the containers at the bottom of the track).

like fresh nonirradiated fish, whether they are compared raw or cooked, and the only difference is that the irradiated fish have at least double the shelf life of nonirradiated fish. The scientists further found that the sooner fish are treated, the longer and better they will keep. In special experiments, some fish were irradiated at sea just after they were caught. Because fresh-caught fish have relatively few bacteria, it was found that only 50,000 rads were necessary to preserve them. This has motivated some scientists to investigate irradiation at sea more thoroughly.

In many undeveloped countries, good quality fish are available only to coastal inhabitants. If the fish could be preserved in a manner which would not alter their quality, they could be transported long distances inland to those areas or countries where protein is scarce. Irradiation preservation is a potential process for this type of situation where refrigeration is generally unavailable.

While the use of ionizing radiation has demonstrated a potential as a processing method in certain applications, it cannot be applied until approval for its use is given by the FDA. The reason for this is that the FDA has declared ionizing radiation to be a food additive and by law all food additives are used only under the approval and regulation of the FDA. Under normal circumstances the FDA requires proof of safety and this is usually demonstrated by animal feeding studies involving generations of specific species of test animals over a specified minimum of time. The most advanced animal testing program presently underway that has the promise of gaining FDA approval for the radiation process is presently being conducted at the U.S. Army Natick Development Center, Natick, Mass.

For additional information, readers are invited to write the Director, Northeast Utilization Research Center, National Marine Fisheries Service, NOAA, U.S. Department of Commerce, Emerson Avenue, Gloucester, MA 01930.

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United States Makes Gains at ICNAF Meeting

Substantial progress was achieved in meeting U. S. fishing quotas and international enforcement objectives at a special meeting of the International Commission for the Northwest Atlantic Fisheries (ICNAF) earlier this year in Rome, Italy, according to David H. Wallace, Chairman of the U. S. Delegation and Associate Administrator of the National Oceanic and Atmospheric Administration (NOAA). Wallace said he was encouraged by the action taken concerning quotas of northwest Atlantic herring stocks and refinements made in the international enforcement procedures.

At its meeting, the Commission acted to:

1) Reduce the 1976 overall catch quota for the overfished Georges Bank herring stock from 150,000 tons to 60,000 tons, and agreed to hold the quota at that level or lower until the stock has fully recovered.

2) Effectively prohibit large foreign vessels from fishing directly for herring between 1 January and 30 June 1976.

3) Increase the U.S. quota for the Georges Bank herring stock to 9,400 tons for the first 6 months of 1976, an increase of 1,000 tons over the entire U. S. quota for 1975. Allocations for the remainder of the year will be considered at the Commission's 1976 Annual Meeting scheduled for 8-23 June in Havana, Cuba.

4) Reduce the overall quota of Gulf of Maine herring from 16,000 tons to 7,000 tons, also subjected to review and possible adjustment at the 1976 annual meeting.

The members of the 18-member-nation body also acted to insure stricter compliance with the increasingly complex system of fishery regulations adopted for the northwest and middle Atlantic. If finally adopted, these recommendations would require nations with large fishing fleets in this area to provide someone in the area to respond to complaints of violations of these regulations and permit ICNAF inspectors to stop fishing which appeared to be contrary to major regulations.

The Commission also acted to provide for possible reductions in a nation's quota when that nation had overfished any of its catch quotas. Member nations also were encouraged to report more fully on inspections and dispositions of infringements of the regulations.

Florida Firm Joins NOAA Fish Quality Program

A voluntary inspection program, conducted by the National Oceanic and Atmospheric Administration and aimed at assuring quality fisheries products, has been adopted by a Florida food processor. The inspection program is managed by NOAA's National Marine Fisheries Service.

Under the program, Harry H. Bell & Sons, St. Petersburg, will be permitted to place a "Packed Under Federal Inspection" (PUFI) mark on its products. The mark attests that the product has been statistically sampled at the time of processing and found to be safe, wholesome, and of good quality.

To meet the high standards required to display the PUFI symbol, a processor of fish products must agree to certification by a Department of Commerce inspector who insures that the conditions under which the products are processed meet high sanitary requirements. All costs of the inspection program are carried by the participating firm. A growing number of processors throughout the United States are joining the program, NOAA officials said.

The company, with a staff of 150, using modern equipment and fresh products, ships Spanish mackerel fillets, stuffed Florida lobster, Florida stone crab claws, and Florida sea trout throughout Florida as well as the southeastern, midwestern, and west coast states.

Fur Seal Conservation Convention Extended

A National Oceanic and Atmospheric Administration (NOAA) official has termed "unfortunate" the failure of delegates to the Interim Convention on Conservation of North Pacific Fur Seals to adopt U.S.-proposed management concepts designed to give more protection to North Pacific fur seals.

Carmen Blondin, Assistant Director for International Fisheries, National Marine Fisheries Service, NOAA, said the group agreed to recommend to their governments that the Convention be extended for another 4 years but missed an opportunity to adopt the concept of optimum sustainable population which is included as a management objective in the Marine Mammal Protection Act of 1972.

Under the new concept proposed by the United States, consideration would have been given to the esthetic and recreational value of the fur seals and the necessity of maintaining the health and stability of the marine ecosystem. The present management concept provides for maintaining populations at levels which permit maximum productivity, taking into account the relationship of fur seals to other marine resources.

The delegates will recommend to their governments that they approve a Protocol providing:

1) That natives, living on the islands where seals breed, be permitted to take seals for food when the meat obtained from the commercial harvest and research is not sufficient for their needs;
2) that the Parties ensure that the methods used to capture, mark, and harvest the seals, on land or at sea, spare the seals pain and suffering to the greatest extent possible;
3) for a suspension or reduction of the fur seal harvest on any island or group of islands where the total number of seals falls below the level necessary to maintain the population at maximum productivity;
4) for research on the relationship between fur seals and other living

marine resources and the effect of commercial fisheries on fur seals;
5) for a termination of the Convention one year after any of the Parties gives written notice to the other Parties of any intention to end the Convention; and
6) for representatives of the Parties to meet within 90 days of a request by any of the Parties to consider modifications of the Convention.

The Interim Convention on the Conservation of North Pacific Fur Seals was entered into in 1957 by the United States, Canada, Japan, and the Soviet Union to regulate the harvest of fur seals in the North Pacific. Nearly 80 percent of the northern fur seal resource is currently associated with the Pribilof Islands of the United States, located off the coast of Alaska.

University Consortium Studies Marine Problems

A newly formed consortium of the University of Maine and the University of New Hampshire has received a $860,000 Sea Grant from the National Oceanic and Atmospheric Administration (NOAA), to support studies in aquaculture, ocean engineering, marine resource development, and marine education, it has been announced by Commerce Secretary Elliot L. Richardson.

Matching funds from the two states will raise the total amount of the grant to almost $1,412,000. Although both universities have received individual Sea Grant support since 1970, this year's funding marks the first time the programs at both are combined.

Because both states share a significant portion of the Gulf of Maine, the two universities will be better able to make a major contribution to solving marine problems there by working together, said Frederick E. Hutchinson, the first director of the cooperative program and Vice President for Research and Public Services at the University of Maine.

Among the most promising of the on-going projects funded this year is a study of the culture of edible blue mussels. Aquaculture researchers at the University of Maine already have set out more than a dozen experimental rafts along the Maine-New Hampshire coast for growing the mussels, a highly-regarded shellfish whose production world-wide exceeds 250,000 tons annually. In cooperation with Abandoned Farm, Inc., the Sea Grant-supported aquaculturists will examine the growth and survival of mussels on the experimental rafts and will monitor the development of mussels reared in the warm-water effluent of an electric power plant in Maine.

In related work at the University of New Hampshire, research will center around the rearing of coho salmon. Special strains of these salmon, adapted to northern New England waters, will be developed and work will continue on improving the diets and disease-resistance of the fish.

Other scientists will pursue work aimed at improving oyster aquaculture, evaluating commercial seaweed production, and understanding the cause of the so-called "red tide" outbreaks that threaten shellfish beds along the New England coast. This latter project is particularly important, since red tide poisoning has forced the closing of large numbers of commercially valuable shellfish areas several times in the past. Investigators so far have identified three of the poisons found in affected shellfish, and are attempting to develop a method to inactivate the poisons and detoxify tainted shellfish.

The combined University of Maine-University of New Hampshire Marine Advisory Service will continue to provide business management information to members of the fishing industry and other users of the marine environment. In addition, a series of seminars, meetings, and special demonstrations is planned this year for students, seafood processors, and the general public.

Foreign Fishery Developments

Soviets Report Views on Law of Sea Issues

The United Nation's Law of the Sea (LOS) Conference convened its third substantive session in New York City on 15 March 1976. Many of the major issues of this Conference were presented in the Soviet daily *Pravda* in a February article entitled "Detente and the World's Oceans" by S. Pavlov.

According to Pavlov's article, the Soviet Union's official policy in regard to international law of sea stems from the increasing use of the oceans by all countries of the world. The development of international cooperation on the high seas depends largely on the procedure for law and order that is established to control the world ocean environment. To establish such a procedure is the main task of the United Nations Law of the Sea Conference.

Among the most important LOS issues is the problem of extension of the Territorial Sea. The Soviet Union, according to the *Pravda* article, advocates a 12-Mile Territorial Sea for every country. Worldwide claims of a 200-Mile Territorial Sea would result in 40 percent of the total ocean area being removed from general use by all countries. However, the Soviet Union does support the concept of the so-called "200-Mile Economic Zone" under which the coastal states have sovereign rights to all living and mineral resources within their respective zones. By supporting this concept, the Soviets hope to show their concern for the developing nations of the world.

On the other hand, they are also concerned about the future of their high-seas fishing fleet, which takes the largest percentage of its catch off foreign shores. To reconcile these two concerns, the Soviet Union supports the idea that if a coastal state fishes only part of the resources within its 200-mile Economic Zone (EZ), then fishermen from other countries should be allowed to fish the unutilized portion. "Developing" coastal states, *Pravda* declares, should receive compensation for allowing foreign vessels to fish in their Economic Zones.

Concerning the 50 countries of the world which have limited access to the ocean (no coastline or very short coastline), Pavlov states that the Soviet Union advocates that these countries be granted certain rights

regarding the use of the resources within the 200-mile Economic Zone.

Another extremely important LOS issue concerns the right of unhindered navigation by vessels of all flags through international straits. According to Pavlov, the Soviet Union views the right of free passage through these straits as vital in giving "aid to young independent states which... become the targets of aggressive intrigues by the imperialistic forces." Special care should be taken to preserve the internal security of countries bordering on the straits.

Other important issues discussed in the *Pravda* article include pollution, marine research, and the use of the seabed beyond the continental shelf. The Soviet Union has expressed concern that if individual countries are allowed to establish pollution standards and regulations stricter than international controls, the developing nations may find it hard to pay the high costs of meeting such standards. This, according to the Soviet Union, would make it more difficult for these countries to create their own merchant fleets and fishing industries. (Source: S. Pavlov, "Detente and the World's Oceans;" *Pravda*, 12 February 1976.)

According to the NMFS Office of International Fisheries, the Soviet Union views the major issues of the LOS Conference in the light of its intense involvement in the utilization of the world's oceans. The Soviet Navy is one of the largest in the world, while the merchant marine of the USSR is becoming an increasingly more important worldwide carrier of freight. The Soviet fishing fleet, the largest in the world in terms of gross register tonnage (though not in terms of catch), is a far-ranging and showy advertisement for Soviet planned food production. Because the Soviets use the oceans on such a large scale, it is easy to understand why the Soviet Union has resisted efforts to change international law which would restrict the movement of ocean-going vessels.

Cuban Stern Trawler Seized and Fined

The U.S. Coast Guard seized the Cuban stern trawler *Golfo de Tonkin*, on 7 January 1976 for a continental shelf fisheries resource (CSFR) violation. The Cuban vessel was fishing in the southern part of Georges Bank about 125 miles southeast of Nantucket Island with bottom gear in an area where lobster traps and boats were present. As a result, the Coast Guard cutter *Chase*, with a National Marine Fisheries Service (NMFS) agent aboard, stopped and inspected the vessel.

The inspection team found 22 lobsters totaling 39 pounds, all but one of which were still alive. In the judgment of the inspection team, based upon the location of the lobsters aboard the vessel, the lobsters were not being immediately returned to the seas as the CSFR law requires. In the opinion of the *Chase* boarding officer and the NMFS agent, the lobsters aboard the *Golfo de Tonkin* would not have survived if the crew had carried out their normal operating procedure. As a result, the *Golfo de Tonkin* was seized and escorted to Boston.

The Coast Guard reported that "the Master displayed extreme reluctance to get the vessel under way for Boston until he was faced with the possibility of more stringent measures including his arrest and removal from the vessel." The Master, Hector Gonzalez, finally agreed to proceed to Boston, but noted that he wished to lodge a protest. The Master's belligerency followed radio communication with Havana.

CSFR seizures are based on the Bartlett Act which prohibits foreign fishermen from taking lobster and other protected species on the U.S. continental shelf. The Act was passed in 1964, but the law was not vigorously enforced until 1975. The new, stricter enforcement guidelines require not only that lobster taken as an incidental catch be returned to the sea immediately, but that foreign vessels reset their trawls in a different location when an "area of concentration" of lobsters is encountered. The U.S. boarding party found that there was no attempt by the trawler's crew to immediately return the lobsters to the sea. The boarding party was still finding lobster in the *Golfo de Tonkin*'s holding tank and among the trash fish

Table 1.—Basic specifications of *Golfo de Tonkin*-class vessels.

Gross Register Tonnage	1,276 GRT
Deadweight Tonnage	1,276 DWT
Draft	4.75 Meters
Length	250 Feet
Width (Beam)	12 Meters
Speed (Maximum)	13.5 Knots
Horsepower	2,670 h.p.
Hold	1,600 m³
Endurance	45 Days
Cruising Range	6,000 Miles

Canada, Spain Discuss Fishery Cooperation

Canadian and Spanish representatives met in Ottawa on 19 and 20 February 1976 to discuss their future cooperation in the field of fisheries. The meeting carried forward discussions held in Ottawa on 15 and 16 January.

The Spanish Delegation was led by Victor Moro Rodriguez, Director General of Fisheries, Ministry of Commerce. The Canadian Delegation was led by L. H. Legault, Director General, International Directorate, Fisheries and Marine Service, Department of the Environment.

The meeting followed the understanding reached on 7 August 1975 between Canada and Spain to consider the elaboration of a bilateral agreement on fisheries cooperation that would establish the terms and conditions governing continued fishing by the Spanish fleet in water off Canada's Atlantic Coast, taking into account anticipated legal and jurisdictional changes in the regime of fisheries management and traditional Spanish fishing in such waters.

The two sides put forward proposals as the possible basis for an agreement on the terms and conditions that would govern continued fishing by Spanish vessels in areas to be brought under Canadian jurisdiction beyond the present limits of the Canadian territorial sea and fishing zones off the Atlantic Coast. On the basis of these proposals they agreed to the terms of an agreement which, if approved by both Governments, would permit Spanish vessels to fish in the area concerned, under Canadian authority and control, for resources surplus to Canadian requirements. The proposed agreement has been submitted for the approval of the two Governments.

Table 2.—Catch of the *Golfo de Tonkin*, by species.

Commodity	Quantity (metric tons)
Whole, frozen	
Grey Sole	2.3
Silver Hake	6.2
Loligo Squid	5.5
Total, whole frozen	14.0
Cod fillets, frozen	0.8
Total	14.8

3½ hours after the catch came on board.

The *Golfo de Tonkin*, a refrigerated stern trawler of the *Golfo de Tonkin* class, was built in Spain in 1969 (Table 1). It is owned and operated by the Flota Cubana de Pesca (Cuban High Seas Fishing Fleet). At the time of the seizure, the vessel had a crew of 59, including 2 Spanish citizens who assist in the operation of the processing equipment. The vessel's catch consisted of almost 15 metric tons of frozen fish and squid (Table 2). The vessel had recently sailed from Havana and had been fishing on Georges Bank since mid-December 1975.

The Cuban Master appeared before the U.S. Magistrate on 9 January, at which time the case was continued until 28 January. The Master was ordered restricted to the vessel, except for court appearances. A Czech diplomat was designated as the representative for the Cubans. As a result of an out-of-court settlement, a civil penalty of $40,000 was paid on 29 January, and the criminal charges against the Master were dismissed. The vessel departed Boston on the same day.

According to the NMFS Office of International Fisheries, the seizure of the *Golfo de Tonkin* is further evidence of increased Cuban interest in North Atlantic fisheries. In 1975, Cuban vessels operated off the New England coast for the first time since 1972. Cuban fishing operations commenced in July 1975 with two stern trawlers, and continued with three in August, four in September and October, one in November, and two in December. Cuban vessels also fish off Canada's Atlantic Coast. One Cuban vessel, the *Playitas*, reported a catch of 635 metric tons (primarily hake) during May 1975. On 28 November 1975, Cuba officially joined the International Commission for the Northwest Atlantic Fisheries (ICNAF), and obtained a 1976 quota of 21,000 metric tons.

On 17 August 1975 the *Playa Verdadero*, another Cuban stern freezer trawler, was seized for a CSFR violation. It was released, however, because of the small amount of lobsters found on board. A report on the seizure of the *Playa Verdadero* (#197), of 29 September 1975 can be obtained from the International Fisheries Analysis Division, F41, NMFS, NOAA, Washington, DC 20235.

MOROCCO REPORTS SARDINE DECLINE

Moroccan landings of European sardine, *Sardina pilchardus*, from January through September 1975 amounted to 107,000 metric tons, a decline of 30 percent from the 152,887 metric tons landed during the same period in 1974 (Table 1). Poor weather, partial overfishing, and reduced effort due to the increased costs of fishing operations contributed to the decline in 1975, according to information obtained by the U.S. Regional Fisheries Attaché in Casablanca.

Vessels operating from the Atlantic fishing port of Agadir (see map) where most of the Moroccan sardine fleet is based, reported sardine landings 41 percent below the same period of 1974. The vessels operating from Safi and Essaouria, also located on the Atlantic coast, indicated 1975 catches slightly above 1974 levels. No explanation was given for the increased landings at these two smaller ports.

The sardine fisheries off the Atlantic coast of Morocco are made possible by local currents and upwelling of water producing suitable spawning conditions and rich feeding grounds for dense populations of plankton-feeding fish. The currents, however, also produce

Table 1.—Moroccan sardine landings by port, Jan.-Sept. 1974 and 1975, in thousands of metric tons.

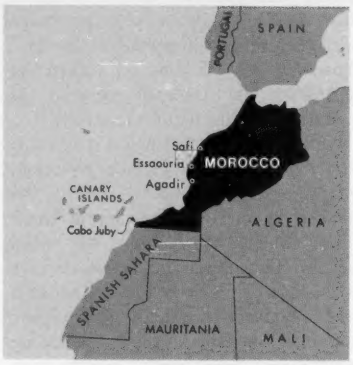
Port	1975	1974	Percent change
Agadir	67.0	113.7	−41.0
Safi	18.0	17.8	+1.1
Essaouria	22.0	21.4	+2.8
Total	107.0	152.9	−30.0

Source: *CEDIES* Informations.

Table 2.—Moroccan sardine catch, by major fishing areas, 1971-73, in thousands of metric tons.

Year	Atlantic	Mediterranean	Total	Atlantic as percent of total
1971	172.6	10.5	183.1	94
1972	171.5	13.4	184.9	93
1973	338.1	11.2	349.3	97

Source: *FAO Yearbook of Fishery Statistics, 1973.*



sharp contrasts in surface temperature along the coast, affecting the availability of sardine schools to the fishers. Upwelled waters along the southern half of the Moroccan coast are as cold in summer as in winter, while the surface waters in the northern half warm up to over 68°F and are almost tropical in character. The warm surface water flows southward but is diverted offshore. The principal sardine fisheries are in the southern cold-water belt, particularly from Safi to Cabo Juby, where upwelled water of 57°-60°F occurs. In the winter the contrast decreases; southern waters remain about the same and northern waters become cooler. As a result of these favorable environmental conditions, more than 90 percent of Morocco's sardine catch is taken in the Atlantic Ocean (Table 2).

The waters of the Mediterranean Sea are much less productive than the Atlantic, but some enrichment is provided along the Moroccan and Algerian coasts by a net inflow of surface water through the Strait of Gibralter. Sardines and other pelagic fish are therefore more abundant in the western than in the eastern Mediterranean.

Morocco's sardine catch is utilized primarily for human consumption. In the first 9 months of 1975, half of the

catch was canned and smaller quantities were frozen or sold fresh. A sizeable portion of the catch was reduced to fish meal (Table 3).

Morocco exports only a limited quantity of canned sardines to the United States. In 1974, such shipments were valued at less than US$340,000. During the first 9 months of 1975 sardine exports to the United States amounted to only slightly more than US$230,000 (Table 4).

According to the NMFS Office of International Fisheries, sardines are Morocco's most significant fishery. Since 1961 they have never comprised less than 60 percent of Morocco's total fisheries and were more likely between 70 and 80 percent of the total catch. The record 1973 sardine catch of 349,000 metric tons contributed nearly 88 percent to Morocco's total 1973 catch (Fig. 1).

The 53 percent increase in the sardine catch in 1973 was apparently due to favorable oceanic conditions which occur every 7-8 years. It is anticipated that the declining sardine catches experienced in 1974 and 1975 will continue through 1977 when catches are once again expected to increase.

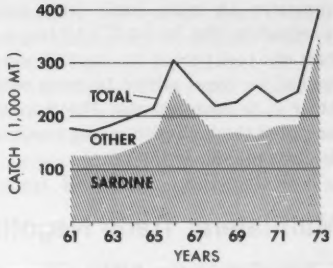


Figure 1.—Total fisheries and sardine catch, 1961-73.

As sardines comprise the bulk of Morocco's fisheries catch, the total landings of all species have also declined (Table 5). As would be expected, the catch of species other than sardines is increasing as the scarcity of sardines forces fishers to harvest other species. Fishers in the three ports harvested only about 15,000 metric tons of fish other than sardines in the first 9 months of 1974. In the same period in 1975 they caught over 40,000 metric tons of other species.

Table 3.—Utilization of Morocco's sardine catch, Jan.-Sept. 1975.

Utilization	Quantity (1,000 MT)	Percent
Canned	53.5	50.0
Fresh	12.3	11.5
Frozen	5.8	5.4
Total, human consumption	71.6	66.9
Reduction (fishmeal)	35.4	33.1
Grand total	107.0	100.0

Source: *CEDIES Informations.*

Table 5.—Fish landings by port, in thousands of metric tons, Jan.-Sept. 1974-75.

Port	1975	1974	Percent change
Agadir	106.7	125.0	—14.6
Safi	18.8	20.4	—7.8
Essaouria	22.6	22.3	+1.3
Total	148.1	167.7	—11.8

Source: *CEDIES Informations.*

Table 4.—Moroccan canned sardine exports to the United States, 1974, Jan.-Sept. 1975.

Type of canned sardines	Jan. - Sept. 1975		1974	
	Quantity (MT)	Value (US$1,000)	Quantity (MT)	Value (US$1,000)
In oil				
Skinned or boned				
23-30¢/lb	—	—	5.3	7.2
Over 30¢/lb	56.4	103.5	95.1	154.6
Total	56.4	103.5	100.4	161.8
Not skinned or boned				
23-30¢/lb	—	—	17.5	20.0
Over 30¢/lb	95.4	110.5	90.2	89.7
Total	95.4	110.5	107.7	109.7
Total, in oil	151.8	214.0	208.1	271.5
Not in oil	8.0	16.5	44.5	67.9
Grand total	159.8	230.5	252.6	339.4

Fisheries Discussed at U.S., USSR Sea Meeting

A meeting of U.S. and USSR fishery representatives took place on 14 January 1976 aboard the Soviet refrigerated transport, *Antanas Snechkus*, anchored 12 miles off Long Island, N.Y., the NMFS Office of International Fisheries reports. Representatives from the Soviet Western Fisheries Administration (Zapryba) and the U.S. National Marine Fisheries Service (NMFS) Northeast Region took part in the meeting, which was organized under the provisions of the U.S.-USSR Mid-Atlantic Fisheries Agreement.

A wide range of subjects relating to Soviet fishing off New England was discussed. Aleksandr Popov, the Fleet Director (Manager) for Zapryba, was the spokesman for the Soviets. The first subject was the 1976 mackerel season which began on 1 January. Forty Zapryba stern factory and freezer trawlers were fishing at the time the meeting took place off the Northeastern U.S. coasts in ICNAF[1] subareas 5 and 6. Popov did not know whether fishing conditions would warrant bringing in additional stern trawlers.

The Ministry of Fisheries in Moscow informed Popov that no formal charges had been made by ICNAF against the Soviets for overrunning their mackerel quota in 1975. Although undersized mackerel (under the 25 cm ICNAF length restriction) had been reported common in 1975, Popov assured the U.S. team that all Soviet captains had been informed of this length regulation. Certain Soviet trawlers are also using a 50-mm mesh size instead of the usual 30-mm one in order to avoid small mackerel. If the experiment is successful, a larger mesh size will be adopted as standard for the entire Soviet mackerel fleet. All mackerel fishing vessels are using mid-water trawls.

In regard to the 1976 herring fishery, Popov confirmed that the Soviets would begin purse seining for herring on Georges Bank again in March 1976. The traditional Georges

[1]International Commission for the Northwest Atlantic Fisheries, an international fisheries regulatory commission of which the Soviet Union is a member. Subarea 5 includes Georges Bank and the Gulf of Maine; statistical area 6 extends from Rhode Island to Cape Hatteras.

Bank autumn stern trawler fishery for herring did not take place in 1975 because exploratory fishing had revealed the stocks to be in poor condition. Light fishing for saury on Georges Bank has proved unprofitable in comparison with the Soviet saury fishery in the Pacific, so the Zapryba fleet abandoned this fishery in 1975.

Popov anticipated a sizable squid fishery in 1976, and believed that the ICNAF squid quota allowed the Soviet Union would be taken in its entirety. The Soviets catch and process squid mainly for export, since the demand for this species in the USSR is low.

The U.S. team asked how a Soviet Fleet Manager knows when the fleet has reached an ICNAF quota. According to the Soviets, their catches are radioed daily to Moscow via Riga. When a quota has been reached, the Fleet Managers are advised of the fact and the fishery for that species is ended at once.

Since the Soviet trawler *Zaraisk* was seized off New Jersey in August 1975 for retention of lobsters, all Soviet captains have been informed once again of the U.S. regulations concerning Continental Shelf Fisheries Resources[2]. Creatures of the continental shelf such as lobsters and crabs must be returned to the sea either dead or alive immediately upon removal from the net.

On the issue of fixed lobster gear areas, Popov agreed to report daily, via Radio Boston, the positions of his fleet. He asked if his vessels would be permitted to pass through lobster gear areas providing all fishing gear were stowed. No U.S. laws prohibit such passage, but Popov was advised his vessels should exercise extreme caution when steaming through reported fixed-gear areas.

The U.S. team asked why the Soviet vessels have not used the port privileges they are allowed under the U.S.-USSR Mid-Atlantic Bilateral Agreement. According to Popov, the regulations involved are simply too excessive to make such port calls worthwhile. The Soviet ICNAF inspectors who took part in the meeting were invited to come ashore to meet with their U.S. counterparts. The Soviets accepted the invitation, and a meeting is planned later in the year.

Both the U.S. and USSR teams agreed that the contact between the two groups was useful and informative. In the future, the two sides hope to hold such meetings more often, perhaps ashore as well as at sea. Popov remarked that he would welcome the opportunity to visit the United States.

[2]Under the Bartlett Act, U.S. Code 1081-1086, a vessel seized for a Continental Shelf Fisheries Resource (CSFR) violation is subject to forfeiture together with its gear and cargo. In addition, the captain of the vessel can be personally fined up to $100,000, or be imprisoned for up to 1 year, or face both fine and imprisonment.

Multilateral Trade Negotiations Held in Geneva

According to the NMFS Office of International Fisheries, the current multilateral trade negotiations (MTN) began in Tokyo in September 1973, with a declaraction by participating nations "(To) achieve the expansion and ever greater liberalization of world trade and improvement in the standard of living and welfare of the people of the world...through the progressive dismantling of obstacles to trade and the improvement of the international framework for the conduct of world trade...(and to) secure additional benefits for the international trade of developing countries..." This MTN round, called the Tokyo Round, is the seventh series of tariff-cutting talks held under the auspices of the General Agreement on Tariffs and Trade (GATT) since 1948. The last one was the Kennedy Round which lasted from 1962-1967, and since 1965 world trade has grown from $188 billion to $806 billion in 1974. The Tokyo Round plans to go beyond simple tariff-cutting and examine the full gamut of trade barriers.

WORKING GROUPS

The Tokyo Declaration, signed by 105 countries, also created the Trade Negotiating Committee (TNC) which met in February 1974 and organized six working groups: 1) The Tariffs Group; 2) The Nontariff Barriers (NTB) Group; 3) The Agriculture Group; 4) The Tropical Products Group; 5) The Safeguards Group; and 6) The Sector Group. Fisheries are currently directly involved in or affected by all of these groups except the "Sector Group."

The "Tariffs Group" is charged with further reducing tariffs. Reductions averaged 35 percent during the Kennedy Round, and the average level of tariffs is presently about 9 percent in the European Community (EC) and the United States, and 11 percent in Japan. The problem in this group is that while the average tariffs are not very high, there are relatively high tariffs on a few items—especially in the United States. There is also a high protection afforded finished manufactured goods relative to semi-processed goods.

There are five broad categories in the "NTB Group:" 1) Government participation in trade (export subsidies, government procurement, countervailing duties, etc.); 2) Customs and administrative entry procedures (duty valuation, customs classification, consular and customs formalities, etc.); 3) Standards and packaging regulations; 4) Specific limitations on trade (quotas, export restraints, licensing, etc.); and 5) Charge on imports (prior deposits, variable levies, etc.). One or more fishery products are affected by each of these categories.

While there are no fishery items in the "Agriculture Group," the results of this Group will greatly affect fisheries. The issue here is the universal political impact of farmers and the equally widespread reluctance to become overly dependent on foreign food sources. In the EC these forces have resulted in a Common Agricultural Policy which is an inherent component of the Community and highly protectionist in a net food-importing area. The EC Common Fisheries Policy is very similar to their Common Agricultural Policy. In the United States these forces have resulted in a net food-exporting area interested in free trade of food items except dairy products.

The "Tropical Products Group" was established because of the increased negotiating leverage of the less developed countries (LDC's). The recent commodity shortages and the fear of more cartels like OPEC created part of the climate for this Group. The Group is discussing specific commodity requests of the LDC's for unilateral liberalization of tariffs and NTB's by the industrial countries.

The "Safeguards Group" is examining GATT Article XIX, which is generally agreed to be too nebulous. Under this Article, countries which perceive that increased imports of a given commodity are injuring, or threaten to injure domestic producers, may take temporary, unilateral action to restrain the inflow of such imports. The "Safeguard Group" is developing a more specific and effective system which could be universally adhered to.

In the "Sector Group," all of the trade issues in a specific industrial sector are examined collectively and simultaneously. Ores and metals (including iron, steel, and aluminum) is the first sector receiving study where all trade barriers occuring anywhere during the processing stage will be discussed.

ISSUES

While there is general agreement that work in a comprehensive series of trade negotiations is preferable to economic warfare and that a reduction of trade barriers would result in a more efficient allocation of resources and an increase in real income, there remain major differences of opinion. Most of these differences are between the EC and the United States and a table of these differences is shown below.

The current Tokyo Round, now underway in Geneva, and all previous rounds of GATT negotiations are a process of institutionalizing trade interdependence. Some tariffs and NTB's to fishery and other products will continue to exist when this Round is completed, setting the stage for future negotiations. (Source: *European Community*, "The ABC's of the MTN's" by Stephen D. Cohen.)

Item	Position	
	European Communities	United States
Agriculture		
Protection	Common Agriculture Policy (Protectionist and food independent).	Free access to food markets except dairy.
Control	International commodity price agreements for cereals, rice, sugar, etc. Formal price floors and ceilings and a concerted stockpiling program.	Systematic and regular exchange of information on worldwide trends in the supply of and demand for agricultural goods.
Tariff reductions		
Approach	Harmonization (greater reduction of high tariffs).	Linear (uniform percentage cuts across-the-board).
Extent	Retain nominal tariff on most imports.	Total elimination of duties which are 5 percent or below and up to 60 percent cut in higher duties.
Timing and staging	Simultaneous conclusion as in the Kennedy Round.	"Early harvest"—piecemeal approach.
Procedure	Has not received an approved negotiating position from the nine member countries through the Council of Ministers.	Limited by what Congress has demanded or is likely to approve.

Fishing Vessel Seizures, Claims Settlements Told

The information below is a listing of the more important fishing vessel seizures and related incidents in recent months, as compiled by the NMFS Office of International Fisheries. The incidents are a demonstration of international tensions in coastal areas and of the increasing competition for fisheries resources.

SEIZURES BY OR OF UNITED STATES VESSELS

The South Korean longliner *Don Won No. 709* was seized on 19 February 1976 less than 12 miles off White Sisters Island, Alaska. The 629-gross-ton vessel is owned by the Dong Won Ice Company of Pusan, Republic of Korea, and had 250 tons of black cod on board at the time of seizure. The vessel was moored in Sitka pending settlement of the case. The U.S. fishing limits extend 12 miles seaward and no foreign vessels may fish there.

The Cuban stern trawler, *Golfo de Tonkin*, which was seized by the U.S. Coast Guard on 7 January 1976, for having continental shelf fishery resources (CFSR) on board, was released on 30 January after the payment of $40,000 in fines. Criminal charges against the master were dropped. Mexico seized a U.S. sport fishing boat on 2 February approximately 2-3 miles off North Coronado Island in the Pacific Ocean. The vessel was apparently fishing for croaker (corvina) without a Mexican license.

OTHER SEIZURES

Australia seized 8 Taiwanese vessels during the 1975-1976 fishing season that were fishing in the Gulf of Carpentaria (as of 27 January 1976). Queensland's commercial fishers accused the Taiwanese vessels of ignoring conservation measures and asked that the Gulf be declared Australian territorial waters.

Costa Rica seized a Nicaraguan fishing vessel on 29 January off Cocinera Island. Five other Nicaraguan vessels escaped. The Nicaraguan vessel was confiscated by Costa Rican authorities on 1 February.

Danish authorities seized a Scottish trawler off the Faeroe Islands on 8 February 1976, for a violation of the Faeroese 12-mile limit, and fined it $13,000. Its gear and catch were confiscated. Danish newspapers also reported several violations by British, Dutch, and Belgian vessels. India seized a Pakistani fishing trawler and its crew of 11 on 4 January 1976 in the Arabian Sea off Gujarat. No further details were available.

Indonesia released a Japanese tuna vessel, the *Akihisa Maru No. 11* and its 15 crewmembers, at the end of December. The vessel had been seized on 3 November 1975.

The Mexican Navy seized a Cuban fishing vessel 8 miles south of Cayo Arcas off the coast of the state of Campeche, according to a Mexican press release of 21 January. The Cuban vessel was being detained in Ciudad del Carmen. The Campeche Banks are one of Mexico's richest shrimp grounds.

The Philippines seized a Taiwanese fishing vessel and its crew of 17 for illegal entry into central Philippine

waters on 15 January 1976 and impounded 5 tons of fish. The Taiwanese claimed that their vessel, the *Hsin Tun Po*, had drifted into Philippine territory due to bad weather.

Libya seized 5 Greek trawlers on 24 and 25 October 1975. Four vessels were seized in the Gulf of Syrti and 1 near Bengazi. Sri Lanka seized a Taiwanese vessel for fishing within Sri Lankan waters, according to a 3 February report from Colombo, and Tunisia seized two Italian fishing vessels on 6 January 1976. They were released after payment of fines totaling $50,000.

SETTLEMENTS OF CLAIMS

Japan has paid South Korea $194,000 to settle claims for damages filed by Korean fishers against Japanese vessels in the joint fishing area between the two nations. Of 168 claims filed by South Korea since 1966, 155 have been settled, eight have been dropped, and five are pending.

Japan protested to the Soviet Union the damage done to Japanese fishing gear off the northeast coast of Japan. Parliamentary testimony in Tokyo on 16 December 1975 reported 79 cases amounting to 17,830,000 yen (US$60,000) had occurred since 23 October, the date Japan ratified the Soviet-Japan Fisheries Operations Agreement. During his ... journ in Tokyo on 9-12 January 1976, the Soviet Foreign Minister promised to free 32 Japanese fishers seized off disputed islands just northeast of Hokkaido and to advise restraint to the Soviet fleet fishing off Japan's coast.

OTHER INCIDENTS

A Chinese freighter rescued nine Japanese fishers from the *Mitsu Maru No. 5* (59 gross tons) who abandoned their tuna vessel after it ran aground on a shoal on 18 December 1975 near the Hainan Islands. The Japanese fishers were taken to Canton where a patrol vessel of Japan's Maritime Safety Agency picked them up on 23 December.

South African shrimp fishers have complained of harassment by Mozambique gunboats in waters off that newly-independent state. As a result, a number of South African fishers have converted their vessels for lobster trapping off the South African coast.

INADEQUATE PORTS SLOW ARGENTINA'S FISHERY EXPANSION

The NMFS Office of International Fisheries reports that Argentina's plans for increasing fish exports and the domestic consumption of fishery products are being impeded by inadequate port facilities which cannot service all of the vessels comprising the Argentine fishing fleet, or efficiently process and distribute the quantity of fish currently being caught.

The most important fishery ports in Argentina are: Mar del Plata, Necochea, Bahia Blanca, San Antonio Oeste, Madryn, and Rawson (see map). The port of Mar del Plata is by far most important as 90 percent of the total Argentine catch is landed there. Despite its inadequate infrastructure, this port is in better condition than the other Argentine ports. There has been a significant increase in the number of vessels in the Argentine fishing fleet[1]. The increased number of vessels has exceeded the capacity of the piers at Mar del Plata, causing many difficulties. There is a shortage of fresh water and the pollution of the harbor makes it difficult to use salt water. Expensive fuel is trucked in at great cost. Additionally, many old vessels in repair congest the fishing wharves since no area is specifically set aside for vessel maintenance. The lack of covered wharves compels workers to process fish catches in the hot sun, causing a loss in quality and price.

The Argentine Government plans to promote the exploitation of coastal resources south of Mar del Plata by developing ports in that area. The plan to develop the port at San Antonio Oeste, for example, provides for the construction of a filleting plant, a freezing plant with cold storage, and a fishmeal plant having a capacity to process 50 metric tons of fish daily. Industry sources maintain that it is also necessary to establish a fishing port north of Mar del Plata, where the Rio de la Plata River empties into the Atlantic Ocean, to enable the exploitation of the large concentrations of anchovies which occur there during winter[2]. This new port could also service the high-seas fleet which catches hake in winter and the coastal fleet which fishes for bonito. (Sources: *Tecnica Pesquera* and *Industrias Pesqueras.*)

[1] In the last 2 years, more than 60 vessels have been added to the high-seas fleet which now numbers 120 vessels. This expansion of the Argentine fleet was made possible by a law which allowed the importation of used fishing vessels without payment of import duties. The law expired in 1975.

Table 1.—Argentina's fisheries catch, 1960-73 (Source: FAO Yearbook of Fishery Statistics, 1973).

Year	Quantity (1,000 MT)	Year	Quantity (1,000 MT)
1960	104.6	1967	241.3
1961	101.9	1968	223.6
1962	101.4	1969	203.4
1963	130.5	1970	214.8
1964	169.0	1971	229.0
1965	205.2	1972	238.2
1966	251.3	1973	302.1

According to the NMFS Office of International Fisheries, in 1973, the Argentine fisheries catch exceeded 300,000 metric tons for the first time (Table 1). Following 3 years of decline, the Argentine catch has increased 98.7 metric tons, or by 49 percent between 1969 and 1973. Over 50 percent of the 1973 catch, or 151,000 metric tons, was Patagonian hake ("merluza"). Sizeable quantities of hawk fish, anchovy, and chub mackerel were also caught.

[2] In Argentina winter lasts from 21 June to 21 September.

Poland Studies Antarctic Krill Fishery

The Government of Poland has organized its first scientific expedition to study Antarctic krill resources, according to the NMFS Office of International Fisheries. Research scientists and Polish fishers have been searching for krill concentrations and investigating the feasibility of harvesting krill for Poland's expanding fishery markets.

Two Polish vessels were sent to Antarctica in December 1975. One of them, the large research vessel *Professor Siedlecki*, had previously studied fishery resources in the coastal waters off southern Africa. The vessel has sophisticated scientific equipment operated by 31 scientists. The second vessel, the *Tazar*, is a smaller, recently-built fishing trawler of the B-417 class. In addition to a crew of 85, the *Tazar* has 6 scientists on board.

The expedition is a joint project organized by the Sea Fisheries Institute of Gdynia and the Polish Academy of Sciences. Associate Professor Stanislaw Rokusa-Suszczewski of the Institute of Ecology of the Polish Academy of Sciences is the senior scientist in charge of the research program.

Krill research was slated to be conducted in the Atlantic part of the Antarctic in the Drake Passage, Weddel Sea, and off Bouvet Island. While the expedition conducted its studies, Polish scientists also anticipated a number of exchanges and meetings with scientific personnel of other research vessels operating in the Antarctic region. However, the two Polish vessels had no foreign scientists on board.

Krill are a shrimp-like crustacean measuring about 5 cm in length and are an important source of food for whales. Due to rapid depletion of whale stocks there is presently an overabundant supply of Antarctic krill. Since krill has a high protein content, its large Antarctic resources could contribute to the protein supplies for the growing world population.

There exist, however, major problems in the harvesting and processing of krill. The Soviet Union and Japan, early pioneers in krill fishing, have largely overcome these problems by developing innovative catching and processing techniques. Soviet technologists have developed a tasty krill paste that is sold in tubes and spreads like butter.

Poland, a latecomer to krill fishing, is now eager to develop its own krill industry and is already planning to introduce large-scale processing lines for production of krill pate in Swinoujscie, Hel, Gdynia, and Kolobrzeg.

FAO Notes Gains in South Vietnam Fishery

Statistics compiled by the Food and Agriculture Organization of the United Nations (FAO) show that the fish catch in South Vietnam has been on an almost steady rise since the mid-1950's (Table 1), according to the NMFS Office of International Fisheries. Constant input from projects funded by such agencies as AID (Agency for International Development) doubtless contributed much to this increase, despite the disruptive conditions prevailing in the country during the last decade. In 1974, the South Vietnamese catch of marine fish totalled 510,000 metric tons, while freshwater fisheries production totalled only 100,000 metric tons. The grand total, 610,000 metric tons, shows a decrease of over 100,000 metric tons from the total catch of the previous year.

The fishing industry in South Vietnam reportedly deploys 43,929 motorized fishing boats, although only 30 of these are high-seas vessels of 100 horsepower or more. Gear, such as nets, ropes, and buoys, is manufactured locally with imported materials. Seven canneries, 62 freezing plants, 293 ice-making plants, and hundreds of smaller enterprises make up the bulk of the South Vietnamese processing industry. Exports of fishery products in 1974 totalled 11,718 metric tons and were worth over US$30 million. Exports of frozen products alone were valued at US$24 million.

Table 1.—Fisheries catch of South Vietnam, 1955-74 (Source: FAO Yearbook of Fishery Statistics, 1973).

Year	Quantity (1,000 MT)	Year	Quantity (1,000 MT)
1955	120.0	1965	375.0
1956	130.0	1966	380.5
1957	135.0	1967	410.7
1958	143.0	1968	410.0
1959	153.0	1969	463.8
1960	240.0	1970	517.4
1961	250.0	1971	587.5
1962	255.0	1972	677.7
1963	378.6	1973	713.5
1964	397.0	1974	[1]610.0

[1]Hanoi Radio.

The new government in South Vietnam is interested in improving production in the fishing industry to increase both domestic consumption and exports. However, the fishing fleet is badly in need of overhaul. Although 60 percent of the fleet is motorized, the vessels, for the most part, have engines with a capacity of only 7-13 horsepower and are therefore unsuitable for profitable high-seas operations. About 91 percent of the vessels are small wooden boats of less than 5 tons. The motors, which were imported over the last 10 years, now need to be overhauled or replaced. Port facilities are also old, outdated, and unsuitable for large-scale fishing operations requiring deep harbors and modern loading equipment. In spite of these drawbacks, the South Vietnamese government has declared its intention to develop a profitable fisheries sector on the basis of the already existing, traditional industry.

Japanese Fish Company Enters Kamaboko Market

When one of Japan's major fishing companies, Nihon Suisan, began manufacturing and selling yakichikuwa, a kamaboko[1] product, about 7 years ago, other Japanese companies, already in this business, protested vigorously. Without recourse to the courts, Nihon Suisan and the existing manufacturers and sellers negotiated a settlement that allowed Nihon Suisan to produce and market this kneaded fish product under a quantitative limitation. Thus Nihon Suisan was allowed to enter the market gradually without causing

[1]Kamaboko products include Kamaboko itself, yakichikuwa, hampen, and agekamaboko. These Japanese terms have no exact English equivalents though they are sometimes translated as fish cake or fish sausage. The basic ingredient for kamaboko products is minced fish (surimi) which is washed, bleached, homogenized, and mixed with seasonings. This product is pressed, rolled, and shaped into the various products listed. The taste of kamaboko products is rather bland, they have a spongy consistency, and they are often eaten at room temperature for snacks.

extreme dislocation to existing manufacturers and sellers. The 1974 production of kamaboko fish products is estimated at 1,150,000 metric tons and the industry is a billion-dollar industry in Japan.

As Nihon Suisan expanded its sales network for yakichikuwa, it continued to study ways of increasing the number of kamaboko fish products it could manufacture and market. In November 1975, Nihon Suisan announced plans to cooperate closely with other manufacturers and sellers in test-marketing other products such as hampen and agekamaboko. Nihon Suisan's expansion into the kamaboko fish product market apparently has been accepted by existing companies on the condition that they obtain orders for production from Nihon Suisan. They will act as subcontractors, supplying products for the diversification of Nihon Suisan's product line. Nihon Suisan's operation is marking time as the cooperative network is coordinated. The company plans substantial production beginning in 1976. (Source: *Nikkei Sangyo Shimbun.*)

Canada Halves Redfish Quotas in St. Lawrence

Canada's Minister of State for Fisheries, Romeo LeBlanc, announced on 3 March that immediate conservation measures will be brought into force to protect the depleted redfish spawning stock of the Gulf of St. Lawrence. Thus, a quota of 30,000 tons was established for the 1976 Gulf of St. Lawrence redfish fishery compared to a 1975 catch of 60,000 tons. In addition, the Gulf of St. Lawrence was closed to all vessels fishing for redfish effective noon March 6 until midnight April 30.

During the closure, vessels conducting fisheries in the Gulf for groundfish species other than redfish could not catch more than 5,000 pounds or 10 percent by weight of redfish per trip. The Minister said that this incidental catch allowance for redfish may be adjusted if a change is found necessary in order to permit continued fishing directed toward other species such as cod and flounder. These new regulations were contained in the Atlantic Redfish Fishery Regulations.

LeBlanc said that scientific assessments indicated the adult spawning stock had declined to a level of about 100,000 tons and that further decline may endanger future productivity of the Gulf redfish. "Consequently, our scientists are recommending that catches be kept as low as possible in order to stabilize the stock at its present level," said LeBlanc. He emphasized that the situation results from natural fluctuations in redfish abundance; in particular low survival of those age groups of redfish which would normally be supplementing the adult spawning stock during the next four to five years.

LeBlanc explained that in recent months Departmental officials held a series of meetings with representatives of the major fishing companies involved, fisher's unions and associations, and the provinces to explain the situation with respect to the Gulf of St. Lawrence redfish stock and to develop a plan to deal with this difficult problem. The problem was first identified at a meeting held in St. John's on 6 February 1973, when the industry was informed that there was already a decline in the redfish stock which would likely be accelerated and that the age groups on which the fishery was based would likely be depleted by 1975. It was recognized at that time that some future control of the fishery would, in all likelihood, be required in order to protect new age groups entering the fishery.

Panama Again Bans February and March Shrimping

Panama's Director of Marine Resources, Carlos Arellano Lenox, announced on 8 January 1976, a seasonal closure on shrimping during February and March 1976 for the white, sea bob, and carabali varieties. This was a repeat of last year's attempt to protect these varieties during the spawning season and reflects the Panamanian Government's concern over the continuing decline in shrimp landings, traditionally a major export commodity. The Government indicated that violators would be heavily fined.

Last year's ban was successful, and the April 1975 catch in Panama was 20 percent larger than in April 1974. Although the suspension period was used for boat maintenance and crew vacations, continuing pressures on the shrimp industry from high fuel costs and low shrimp prices make the potential benefits of the closure seem illusory to many Panamanian shrimp fishers.

According to the NMFS Office of International Fisheries, Panama's shrimp catch increased from 3.7 million pounds in 1954 to a peak of 15.6 million pounds in 1964. The catch has since decreased, suggesting that the maximum sustainable yield (MSY) for this fishery has been reached. In 1974, the shrimp catch was 11.7 million pounds, a little less than the 12.3 million pounds landed in 1973. Table 1 provides

Table 1.—Panama's shrimp catch[1], by species, 1954-74, in thousands of pounds.

Year	White	Pink	Sea bobs	Caraballi	Solenocera	Fidel	Cabezon	Total[2]
1974	3,841	3,021	3,667	364	104	147	507	11,651
1973	5,144	3,062	2,885	288	89	207	592	12,266
1972	5,120	2,983	3,133	219	189	—	—	11,643
1971	4,240	2,950	6,485	202	104	—	—	13,982
1970	4,359	2,568	8,045	209	20	—	—	15,200
1969	4,248	2,266	5,541	176	232	—	—	12,231
1968	4,346	4,211	4,357	286	—	—	—	13,200
1967	5,448	2,805	5,709	215	—	—	—	14,177
1966	5,239	2,499	4,308	326	—	—	—	12,372
1965	4,991	2,841	4,162	831	—	—	—	12,825
1964	5,034	2,510	7,119	893	—	—	—	15,556
1963	3,463	2,901	5,287	659	—	—	—	12,310
1962	4,558	3,402	4,814	510	—	—	—	13,284
1961	4,625	2,586	4,444	461	—	—	—	12,116
1960	4,068	1,843	4,365	324	—	—	—	10,602
1959	4,298	1,000	5,228	781	—	—	—	11,307
1958	3,737	293	4,952	319	—	—	—	9,306
1957	4,268	3,183	2,095	195	—	—	—	9,721
1956	4,455	399	1,286	69	—	—	—	6,209
1955	3,319	34	780	3	—	—	—	4,136
1954	3,288	4	367	—	—	—	—	3,659

[1]Source: Direccion General de Recursos Marinos, Ministry of Commerce and Industries, Panama.
[2]Figures may not agree because of rounding.

statistical data on Panama's shrimp catch, by species, for the period 1954-74.

A report on Panamanian fisheries, containing a detailed description of the shrimp fishery has been prepared by the Office of International Fisheries of the National Marine Fisheries Service. Copies can be obtained by requesting Foreign Fisheries Leaflet 75-1: "Fisheries of Panama, 1973," from the Services Branch, D825, ESIC, EDS, NOAA, Department of Commerce, Washington, DC 20235. All requests must include two self-addressed labels to facilitate mailing.

Baltic Fishery Group Proposes Regulations

The following is a summary of the results of a 6-8 January 1976 meeting in Warsaw, Poland by an ad hoc group of the Baltic Fisheries Commission, prepared by the U.S. Regional Fisheries Attaché in Copenhagen.

1) The ad hoc group recommended that the Commission should appeal to the member states to limit their 1976 sprat, herring, and cod catches to the level indicated in the following table.

Country	Sprat	Herring	Cod
	(*Metric tons*)		
Denmark	13,600	29,274	66,050
Finland	5,500	73,066	160
GDR	22,800	70,855	25,979
FRG	6,100	24,036	25,081
Poland	63,500	61,457	68,440
Sweden	10,600	61,388	29,582
USSR	152,900	125,900	43,610
Total	275,000	445,976	258,902

2) The group recommended that a uniform mesh size for sprat (either 10 or 11 mm bar length) and a standard method of measurement of each mesh be defined at the next session of the Commission. Denmark received approval for the option to transfer 10 percent of their herring quota to sprat should they so desire. Finland's by-catch of sprat in their herring fisheries will be excluded from their sprat quota.

3) The group recommended that Finland's herring quota be increased to 80,000 tons because of relatively good herring stock condition currently in area adjacent to Finland. They also expressed deep concern as to the possible effect on the herring stocks because of the high catches of juvenile herring, and although they were unable to reach a unanimous opinion on any protection measures at this meeting, they recommended discussions on this problem be continued at the next Commission meeting. Based on the preliminary 1975 cod catch statistics, the group recommended that the 1976 cod catch in the Baltic Sea should not exceed 266,000 tons.

4) The group recommended that a total allowable catch and national quotas for herring and cod should be introduced on 1 January 1977.

5) The Chairman of the group said that the Baltic Salmon Commission would like to include its regulatory measures for salmon and trout fisheries into the fishery rules of the Baltic Fishery Commission. This subject will be included on the agenda at the next Commission meeting. They also agreed to discuss at the next session a possible enforcement scheme for the Baltic fisheries and asked delegates to bring their proposals for enforcement to the next Commission meeting (scheduled for September).

Japan's Salmon Returns Are Unexpectedly High

The number of salmon returning to the rivers of northern Honshu and Hokkaido has been reported to be exceptionally high in the fall 1975-winter 1976 season. Individuals connected with salmon hatcheries in Hokkaido predicted that 7 million fish would be caught in coastal and river fisheries, but the actual figure approached 15 million salmon. This is an increase of 50 percent over the 1974-1975 season. Although the rate of return of salmon fingerlings usually lies between 1 and 2 percent, economically, the "rate of return" is much higher. The annual investment of ¥1 billion (US$3.3 million at ¥305 = $1) results in ¥50 billion (US$164 million) of landings.

While the unexpectedly high return of salmon is not completely understood, Japanese experts say the 1975-1976 season coincides with the best year of a 4-year cycle and that the improved efficiency of hatchery techniques is partly responsible. Six hundred million salmon fingerlings were released in 1971 and this year-class makes up the major share in the 1975-1976 catch. The Japanese are able to delay the time of release slightly so that the size of the fingerlings and water temperatures are better suited for growth. The experts admit that even such improvements in technique are inadequate to explain this season's catch. (Source: *Nihon Keizai Shimbun*.)

More than 60 salmon hatcheries operate in Hokkaido and the budget of Japan's Fishery Agency for fiscal 1976 (April 1976-March 1977) includes $3.42 million for their operation, according to the NMFS Office of International Fisheries.

Fishery Violations Noted in the Faeroe Islands

A Scottish trawler has been seized and fined $13,000, and its gear and catch confiscated for fishing within the Faeroese 12-mile limit. Danish newspapers reported on 7 and 8 February that other vessels, predominantly British, but also Dutch and Belgian, have been fishing within the Faeroese limit. There were reportedly 25-30 United Kingdom vessels operating off the islands.

Newspapers have accused foreign vessels of fishing within the 12-mile limit at night to avoid detection, and have theorized that Iceland's extension of its fisheries limit to 200 miles is causing fleets which would normally fish in those waters to look for other grounds. The Faeroese are also concerned that a large spawning area north of the islands and outside of the 12-mile limit will be fished, even though the area has been declared a conservation zone. Fishing is prohibited in this area from February to April and it is patrolled by Danish vessels.

Poul Olsen, Chairman of the Faeroese Legislative Assembly, recently told the press he was concerned about foreign fishing, and hoped existing fishery patrols would control illegal fishing operations. He stressed that the Faeroese wish to maintain good relations with nations which have traditionally fished in Faeroese waters, but mentioned that a new patrol vessel would be added to the fleet in April.

According to the NMFS Office of International Fisheries, the United Kingdom, Denmark, Belgium, the Federal Republic of Germany, France,

Norway, and Poland signed an agreement in January 1974 regulating fishing within Faeroese waters. It limits catch by species, season, vessel, and gear, and bases quotas on catches in 1968-72, and applies to all fishing in waters adjacent to the Faeroes.

The Faeroese economy is totally dependent on fish, as over 95 percent of all exports in 1974 were fishery products. Continued incidents, like that of the Scottish trawler violation, may lead to renewed pressures for the Faerose to extend their fisheries jurisdiction.

EC Sets New Fishery Product Guide Prices

The Council of the European Communities (EC) by Regulation Nos. 3304/75 and 3305/75 of 16 December 1975 has established 1976 guide prices on fishery products (see table, right).

By Regulation No. 3306/75 of 16 December 1975, the EC has established intervention prices for the following fresh or chilled items:

Species	Commercial specifications: Freshness	Size	Presentation	Intervention price[1]: 1975	1976
Atlantic sardines	Extra	2	Whole	$232	$232
Mediterranean sardines	Extra	2	Whole	131	144
Anchovies	Extra	2	Whole	216	227

[1]US$ per metric ton.

The Community producer price for yellowfin tuna intended for the canning industry has been maintained at the 1975 level of 657 units of account (u.a.) per metric ton (US$769) for the first 2 months of 1976 according to Regulation (EEC) No. 3307/75 of 16 December 1975. These are for whole fish, not weighing more than 10 kg each.

According to the NMFS Office of International Fisheries, guide prices and Community producer prices for 1976 were increased on 15 out of 18 fishery items. On the other three items prices were maintained at 1975 levels. The simple average increase on all 18 items was 12.5 percent. The guide and Community producer prices are based on the average prices recorded on representative wholesale markets or in representative ports during the three fishing years immediately preceding. These guide prices are used to determine the intervention prices, withdrawal prices, reference prices for imports, and the level of financial compensation in these activities.

Intervention prices are between 35 and 45 percent of the guide price and are fixed at a level which contributed to the stabilization of market prices without leading to the formation of structural surpluses within the Community. When market prices are below the intervention price for three successive market days, the Commission declares the market to be in a state of serious crisis. The product is then purchased for nonhuman use at the intervention price. Withdrawal prices and reference prices for imports are between 60 and 90 percent of the guide prices.

Species	Commercial Specifications	Guide Price[1]: 1975	1976
Sardines	Frozen, in lots or in the original packages containing the same products	284	369
Sea bream (*Dentex dentex and Pagellus*)	Frozen, in lots or in the original packages containing the same products	810	810
Squid (*Loligo* sp., *Ommastrephes sagittatus, Todarodes sagittatus, Illex coindetti*)	Frozen, in the original packages containing the same products	1,461	1,609
Cuttlefish (*Sepia officinalis, Rossia macrosoma,* and *Sepiola rondeleti*)	Frozen, in the original packages containing the same products	847	1,018
Octopus	Frozen, in the original packages containing the same products	613	796

Species	Commercial Specifications: Freshness category	Size	Presentation	Guide Price[1]: 1975	1976
Herrings	A	1	Whole fish	241	266
Sardines (*C. pilchardus* Walbaum)					
Atlantic	Extra	2	Whole fish	515	515
Mediterranean	Extra	2	Whole fish	291	321
Redfish (*Sebastes marinus*)	A	2	Whole fish	500	559
Cod	B,	2	Gutted fish with head	544	626
	or A	3	Gutted fish with head		
Saithe	B,	2	Gutted fish with head	319	358
	or A	3	Gutted fish with head		
Haddock	A,	2	Whole fish	406	467
	or A	3	Gutted fish with head		
Whiting	A	2	Gutted fish with head	445	498
Mackerel	Extra,	2	Whole fish	246	259
	or A	2	Whole fish in original boxes		
Anchovies	Extra	2	Whole fish	481	505
Plaice	A	3	Gutted fish with head	509	611
Hake	A	2	Gutted fish with head	1,170	1,310
Shrimp (*Crangon sp.*)	A	1	Simply boiled in water	1,049	1,259

[1]US$ per metric ton, converted from units of account (u.a.) at one u.a. = US$1.17.

Canada Tightens Rules for Lobster Fishing

Romeo LeBlanc, Canadian Minister of State for Fisheries, has announced new measures designed to exclude part-time fishers from the Canadian lobster fishery. The measures consist of a temporary freeze on the issuance of new licenses, effective on 31 December 1975, and a review and probable revocation of existing licenses held by those who are not dependent upon the lobster fishery for their income. By reducing the number of licenses it is expected that the lobster catch will increase for full-time fishers.

The tighter license controls and other management changes are in accordance with recommendations of a task force on lobster which was established in 1974. In interviews with this group, fishers demanded protective measures to reduce competition

from "poachers." Minister LeBlanc, describing the results of the task force, said "The fishermen demanded strongly that we exclude 'moonlighters' from this fishery... We have no intent to disturb the part-time fisherman with real dependence on the lobster fishery or the man using his boat in more than one fishery." Twenty thousand people now take part in the Atlantic Coast lobster fishery, which yielded C$37 million (C$1.00 = US$1.006) in 1974, the highest for any Atlantic Coast fishery.

The new controls are the first step in the process to strengthen the whole Atlantic coast fishery. Part-time lobster fishers were to have received notification by January 20 that their fishing privilege had been called into question. Those engaged in other full-time occupations will lose their privilege to fish lobster. (Source: Environment Canada.)

EC Plans Small-Scale Inshore Fishery Cnanges

The Commission of the European Communities (EC) has submitted to the Council of Ministers a two-part proposal for restructuring their small-scale inshore fishing industry. The first part involves modernization of the fleets and shore installations for preserving, processing, and marketing fish, together with the development of the aquaculture sector including fish, crustacean, and mollusc breeding.

The second part involves the withdrawal of old, uneconomic vessels and encouragement of fishers 55 years and older to retire. Funds for both of these activities (estimated to be $138 million for 5 years) would come from the European Agriculture Guidance and Guarantee Fund (EAGGF).

Aid from the EAGGF would be in the form of capital grants (of up to 25 percent) to producers with 5 years experience whose vessels do not exceed 24 meters and who have been involved in breeding fish, crustaceans, or molluscs. The beneficiaries would have to provide at least 50 percent of the capital and the member states would have to contribute at least 40 percent of the sum granted by the EAGGF. Maximum rates from both sources would be $1,050 per year for married fishers, $700 per year for unmarried fishers, and $230 per gross registered ton (GRT). The Commission estimates that during the first 5 years of the scheme, 26,000 fishers could retire and vessels totalling 80,000 GRT could be scrapped. The total funds would be about $60 million for the first 5 years of life annuities and $20 million for vessel scrapping.

The Commission proposed that the member states prepare multiannual regional plans to guide the restructuring of the small-scale inshore fishery. These plans would be examined by the Standing Committee for the Fishing Industry and approved by the Commission. Projects selected under these plans must contribute: 1) toward reorienting production and improving the quality of fishery products; 2) to adjusting catch sizes and storage, packaging, and processing capacity to market requirements; 3) to improving working conditions and safety of personnel; and 4) to protecting both the environment and consumer's interests. Priority projects will be those helping to resolve difficulties following adjustments to extended jurisdiction. Those carried out in regions in which the European Regional Development Fund may intervene, or those implemented by recognized producers' organizations or associations.

Iceland Axes Diplomatic Ties with U.K.

Iceland formally severed diplomatic ties with Britain on 19 February 1976, becoming the first NATO nation to do so since the organization was founded in 1949. The Icelandic Government said the continued presence of British warships in its waters was the chief reason for the action. The United Kingdom had withdrawn its warships from Icelandic waters on 20 January, after Iceland had threatened to break diplomatic relations, but ordered their return on 6 February, after Icelandic gunboats continued to harass British trawlers.

The United Kingdom has made several attempts to negotiate a settlement recently, but Reykjavik has not responded. Britain's fisheries treaty with Iceland expired in November 1975, and the Icelanders, faced with growing economic problems at home and increasing concern about the depletion of their fish stocks, proposed a reduced British catch of 65,000 metric tons of fish, compared to a 1975 quota of 130,000 metric tons. Britain has reportedly suggested compromises, including a lower quota of 85-100,000 metric tons, or a percentage of the total catch in Iceland's waters. The decision to sever ties with the United Kingdom demonstrates Iceland's unwillingness to move from its 65,000 metric ton offer.

According to the NMFS Office of International Fisheries, both nations will be confronted by serious economic and political consequences as a result of the eventual negotiations. Iceland is suffering from a high inflation rate and general economic discontent, which led to a general strike by the country's largest union, which lasted from 16 February through 28 February 1976. Since the country is highly dependent on its fishing industry, there is strong public pressure to reduce or eliminate foreign fishing in its newly-claimed 200-mile fishing zone. Britain, on the other hand, is faced with growing unemployment and economic problems in its fishing industry and the government does not wish to present the appearance of giving in to what it feels to be unfair demands. The British distant-water fleet reportedly consists of only 260 vessels, 100 less than in 1974. Unemployment among fishers along England's east coast fishing towns is extremely high: a U.S. news magazine claimed that 2,500 of the 4,000 fishers in the port cities of Hull and Grimsby were unemployed in February.

Soviet Trawler Runs Aground off Alaska

The *Samarga*, a Soviet *Maiakovskii*-class large freezer stern trawler, ran aground about one mile northwest of Kayak Island in the Gulf of Alaska on 31 December 1975. The vessel was transiting the Kayak Island loading zone[1] in heavy snow squalls when the accident occurred. Initial refloating attempts by two other Soviet stern trawlers were unsuccessful, and the *Samarga*'s captain requested U.S.

[1]Areas west and east of Kayak Island are designated as loading zones for the Soviet fishing fleet under the U.S.-USSR Pacific Fishery Agreement.

Coast Guard assistance. The Coast Guard cutter *Confidence* arrived on the scene 2 January 1976 to give aid.

The *Samarga*, hard aground on a rocky bottom, remained aground for over 2 weeks while repeated attempts to refloat it failed. U.S. Coast Guard observers were concerned about the possibility of oil pollution, because the vessel was in a vulnerable, unstable position and likely to break up in heavy seas. About 100,000 gallons of diesel fuel were removed from its hold to alleviate the danger of an oil spill. All other loose ballast was also offloaded, including 100 metric tons of frozen fish, in the hope that the lightened vessel would float free. The Soviet fish carrier *Ostrov Shmidta* and trawler *Belkino* remained alongside the *Samarga* with cables attached to steady it and prevent further damage.

Although Soviet fishery officials brought salvage equipment to the scene for a refloating attempt, under U.S. law (46 USC 316D), no foreign vessel may conduct salvage activities in U.S. territorial waters unless no U.S.-owned vessels are available to do the work. The Soviets were obliged, therefore, to negotiate with U.S. salvage firms for a contract to refloat the *Samarga*. However, before a salvage contract could be signed, the *Samarga* floated free at high tide 17 January with the assistance of the two Soviet vessels steadying it. All three vessels departed U.S. territorial waters with the *Samarga* in tow.

Fishery Developments Around the World

The NMFS Division of International Fisheries Analysis, which follows trends in world fisheries for the National Marine Fisheries Service (NMFS), has prepared the following summary of the recent significant developments in world fisheries.

Mexico published a constitutional amendment establishing the 200-mile Exclusive Economic Zone (EEC) in the *Diario Oficial* on 6 February 1976. The Amendment entered into force on 4 June 1976.

Soviet-Canadian fishery talks ended in Ottawa on 9 February 1976. The two sides agreed to one-year extensions of the Soviet-Canadian Northeast Pacific Fisheries Cooperation Agreement, and the Navigation and Fisheries Safety Agreement.

Sovhispan, a company representing the Soviet fishing fleet in Spain, has announced plans to build a $1.8 million complex to service Soviet fishing vessels based in the Canary Islands. Sovhispan already manages extensive port facilities for the fleet in Las Palmas, Canary Islands.

Fransov, the first joint Soviet-French fisheries company, was formed on 14 October 1975, through an agreement signed by the Soviet Minister of Fisheries and representatives of the French fishing company Casacrus. Fransov vessels will operate in the Far East, off Africa, and off South America.

The USSR and Somalia, as part of a continuing fisheries cooperation program, have agreed on a project to develop the Somali fish-processing industry. In addition, 20 specialized fishery cooperatives will be established.

The Republic of Korea will extend its territorial waters to 12 miles and its fishing rights to 200 miles, according to a report from Seoul. An official decision will be delayed until after the New York Law of the Sea meeting. Such an extension would lead to renegotiation of the Japan-Korea agreement of 1965 which was based on 3-mile territorial sea.

Peru and Poland agreed to extend a 1971 scientific and technical agreement providing for increased cooperation in the fisheries sector. Poland agreed to build four factory trawlers for Peru, and the first is due in Peru in January 1977. Poland also agreed to study Peruvian requests to grant 10 fishery scholarships, provide a research vessel, and supply food fish to Peru.

Fishery Notes

California Dungeness Crab Fishery Gets Good Start

The 1975-76 California Dungeness crab (*Cancer magister*) fishery has experienced its best beginning in 4 seasons. From 11 November 1975 through January 1976, California crabbers landed an estimated 5 million pounds. Crabs were abundant, easily caught, large, and in excellent condition, and the weather was excellent through January. Landings might have been even greater if limits had not been imposed for boats in some areas because of the large volume crossing the docks.

The Dungeness crab is found only in the Pacific Ocean ranging from Baja California north to the Aleutian Islands. It is considered rare south of Point Conception in California.

Dungeness crabs are harvested commercially in California from Avila to the Oregon border. Prior to the 1944-45 season, the fishery was centered around San Francisco. The average annual statewide production, up to then, was 2.6 million pounds. The fishery expanded into the Eureka-Crescent City area toward the end of World War II, which increased statewide landings.

Introduction of the crab pot in the early 1940's replacing the hoop net also improved the landings. Since the 1945-46 season, the average annual statewide production has been 10.7 million pounds, a fourfold increase over the pre-1945 average. Most of that increase can be credited to expansion of the fishery in the northern part of the state.

Landings declined from 15.4 million pounds in 1970 to 685,000 pounds in 1974. This was a decrease of 14.7 million pounds during the five year period and a decrease of 18.4 million pounds from the record 19.1 million pounds in 1957.

Unlike most other fishery products, Dungeness crabs are marketed in a rather small geographic area. During years of abundance, crab marketing is a problem since the regular market has difficulty absorbing the product. These years of unusual crab abundance have a tendency to cycle; there is no assurance the abundance of crab will occur again the following season.

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New NMFS Scientific Reports Published

The publications listed below may be obtained from either the Superintendent of Documents (address given at the end of title paragraph on affected publications) or from D825, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235. Writing to the agency prior to ordering is advisable because prices change and prepayment is required for all orders.

NOAA Technical Report NMFS CIRC-393. Diener, Richard A. **"Cooperative Gulf of Mexico estuarine inventory and study—Texas: Area description."** September 1975. 129 p.

ABSTRACT

Seven Texas estuarine areas are described in terms of their dimensions; major vegetation types; geology and geological history; drainage basins and stream discharge records; hydrological, biological and benthic properties; populations and economic development; pollution; and navigation projects. These areas include the Sabine Lake, Galveston Bay, Matagorda Bay-Brazos River Delta, San Antonio Bay, Copano-Aransas Bay, Corpus Christi Bay, and the Laguna Madre. A list of pertinent literature is also presented.

The estuaries cover over 1,532,000 acres (620,460 hectares) of open waters and are surrounded by an additional 1,141,400 acres (462,267 hectares) of marshlands and tidal flats. They are formed from either drowned river mouths or the development of barrier islands and peninsulas, and are late Pleistocene and Recent in age. Approximately three-fourths of the more than 39,000 cubic feet per second entering these waters from gaged streams enters Sabine Lake and Galveston Bay.

Water temperatures are generally lower on the upper coast than the lower coast during the winter but are relatively uniform during the summer. Salinities generally range from about 5 to 25‰ except in the Laguna Madre area where hypersalinity is common. A rich and varied fauna displaying many varied life-history types is supported by these waters.

Human populations in Cameron Parish, La., and Texas counties contiguous to the seven estuarine areas increased from 31,751 persons in 1850 to 2,962,125 persons in 1970. A sharp increase resulted when oil production began in 1901, and an economy based on manufacture of petrochemicals, shipping, and other industries expanded. Beef cattle and cotton are the mainstays of Texas coastal agriculture, with rice important on the upper coast while citrus fruits are important to the economy of the lower Laguna Madre area. The Texas coast is also important for its sport and commercial fisheries and for waterfowl hunting.

Pollution from domestic and industrial sources has forced the closing of about 325,090 acres (131,661 hectares) of open bay waters to shellfishing and an additional 16,600 acres (6,723 hectares) closed on a conditional basis. Over 1,050 miles (1,691 km) of Federal navigation channels are situated on the Texas coast, the most important of which is the Gulf Intracoastal Waterway, which extends from the Sabine River to Brownsville. Large areas of open estuarine waters, especially in the Sabine Lake and Galveston Bay areas, have been displaced by large spoil areas.

NOAA Technical Report NMFS SSRF-696. Husby, David M., and Gunter R. Seckel. **"Large-scale air-sea interactions at Ocean Weather Station V, 1951-71."** November 1975. 44 p.

ABSTRACT

The meterological observations at OWS-V (Ocean Weather Station V, lat. 34°N, long. 164°E) were used to compute large-scale air-sea heat exchange processes and wind stresses for each month from September 1951 to March 1971. The monthly values are tabulated as anomalies from the 1955 to 1971 means. The quality of the data record and the accuracy of the derived heat exchange components are discussed.

The air-sea interaction climatology at OWS-V, which lies in the net annual heat loss area of the western North Pacific, is described. At this station the average monthly heat exchange across the sea surface is estimated to range from a gain during July of 307 cal $cm^{-2}day^{-1}$ to a loss during December of 388 cal cm^{-2} day^{-1} with an annual loss of 32 cal cm^{-2} day^{-1}. The principal process causing monthly and seasonal variations in the net heat exchange across the sea surface, besides the radiation from sun and sky, is the heat used for evaporation. The average monthly heat lost through evaporation is estimated to range from 86 cal $cm^{-2}day^{-1}$ during July to 374 cal $cm^{-2}day^{-1}$ during December with an annual average of 234 cal cm^{-2} day^{-1}. Anomalous evaporation rates are caused by anomalous "vapor pressure differences" (saturation vapor pressure at the sea-surface temperature minus the vapor pressure of air) and/or anomalous wind speeds.

NOAA Technical Report NMFS SSRF-697. Wilk, S. J., and M. J. Silverman. **"Fish and hydrographic collections made by the research vessels *Dolphin* and *Delaware II* during 1968-72 from New York to Florida."** January 1976. 159 p.

ABSTRACT

Information is given in tabular form for fish and hydrographic observations collected during 18 cruises made by the research vessels *Dolphin* and *Delaware II* from New York to Florida during 1968-72. Tables include station locations with related hydrographic observations and number, weight, and size range of fish species caught.

NOAA Technical Report NMFS SSRF-698. Wilk, Stuart J., and Myron J. Silverman. **"Summer benthic fish fauna of Sandy Hook Bay, New Jersey."** January 1976. 16 p.

ABSTRACT

Thirty-eight species and 25 families of fishes were captured during an otter trawl survey in Sandy Hook Bay, N.J. during July to October 1970. Distribution, abundance, length and age composition, and environmental preferences were analyzed for the more numerous species. Winter flounder, *Pseudopleuronectes americanus;* striped searobin, *Prionotus evolans;* windowpane, *Scophthalmus aquosus;* and northern searobin, *Prinotus carolinus,* accounted for 68.3 percent by number and 66.4 percent by weight of the total survey catch.

Pacific Salmon, Shrimp Harvests, and Dogfish

....Washington State's increasingly popular and successful dogfish fishery was extended beyond its 15 February expiration date to 14 April, the Department of Fisheries has reported. Officials there see a dual benefit in the fishery: Much-needed reduction in dogfish and an increase in export sales. Between April 1975 and February 1976, more than 700,000 pounds of the underutilized species was harvested for export as a food item to Germany and Great Britain. State officials hope that it will develop into a year 'round industry....

....Plans for the first International Conference on Chitin/Chitosan have been announced by its co-hosts, the Massachusetts Science and Technology Foundation and the Sea Grant Program of the Massachusetts Institute of Technology. Conference dates eyed are either November 1976 or April 1977. Latest details on the Conference and scheduling are available from Vincent R. LoCicero, Conference Manager, Massachusetts Science and Technology Foundation, 10 Lakeside Office Park, Wakefield, MA 01880....

....Washington State's largest sport-caught coho salmon (*Oncorhynchus kisutch*) is the 26.5-pounder taken by George Dragoo of Aberdeen in the Satsop River last season, the Department of Fisheries reports. The previous record was a 26-pounder taken at Westport several years before. The world record coho, 31 pounds, was taken at Cowichan Bay, Vancouver Island, B.C., Canada....

....The traditional oyster rearing method, bottom culture, may be replaced by raft, rack or out-bay culture in some Oregon estuaries report fisheries scientists with Oregon State University in Corvallis. New studies will involve placing seed oysters on the bottom of commercial growing grounds, on oyster growing trays and on experimental rafts. At the same time, other oysters will be raised in artificial seawater and the growth and survival of all will be compared. The scientists hope that their research will provide a link between production of hatchery seed and the culture of marketable oysters. They also hope to increase productivity in areas now considered marginal for oyster culture....

....Roy W. Hann, Jr., has been named acting director of Texas A&M University's Center for Marine Resources, the University reports. Hann, who will retain appointments in the Civil Engineering Department and Texas Engineering Experiment Station and as a resident scholar in the Center for Energy and Mineral Resources, will administer the University's $2.3 million Sea Grant College Program and coordinate other marine-related programs....

....South Carolina's $10.5 million 1975 shrimp harvest (dociside value, $1.90/lb, heads off) was a new record for the state's shrimpers, reports the Wildlife and Marine Resources Department. The 1974 dockside price was only $1.02/lb and the catch was 4,754,852 pounds versus 1975's 5,533,675 pounds. Meanwhile, 1975 oyster landings dipped slightly to about one million pounds (at $650,000) compared with 1.1 million pounds (at $657,000) in 1974. The 1975 clam harvest was 170,000 pounds of meat at $221,000, compared with 123,000 pounds in 1974 at $132,000. The blue crab catch declined from 7.5 million pounds in 1974 to 6.2 million pounds last year while mullet landings were about the same at 842,000 pounds. Black sea bass landings, 142,000 pounds, continued to drop and spring herring marked another decline with only 18,000 pounds landed....

....Arm wrestling octopi is against the law in Washington State, says Fisheries Director Don Moos, following reports of divers forcing the Puget Sound creatures out of their dens with chemicals and "wrestling" or "tumbling" them. Adds Moos, "Molesting or harassing food fish or shellfish without the intent of taking them for human consumption is a misdemeanor. The use of chemicals on octopi is specifically prohibited by fisheries regulations, and there is evidence that octopi treated in this way often die afterwards." Use of instruments which penetrate or mutilate octopi is prohibited, as is the unlicensed commercial sale of octopi. The state's daily personal-use harvest is two octopi....

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